FISCAL YEAR 1991 DEPARTMENT OF ENERGY AUTHORIZATION

(Renewable Energy and Energy Conservation)

HEARING

BEFORE THE

SUBCOMMITTEE ON
ENERGY RESEARCH AND DEVELOPMENT

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY HOUSE OF REPRESENTATIVES

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

JUNE 6, 1990

[No. 140]

VOLUME III

Printed for the use of the
Committee on Science, Space, and Technology

U.S. GOVERNMENT PRINTING OFFICE

32-540 WASHINGTON : 1990

H701-89

For sale by the Superintendent of Documents, Congressional Sales Office
U.S. Government Printing Office, Washington, DC 20402

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

ROBERT A. ROE, New Jersey, *Chairman*

GEORGE E. BROWN, JR., California
JAMES H. SCHEUER, New York
MARILYN LLOYD, Tennessee
DOUG WALGREN, Pennsylvania
DAN GLICKMAN, Kansas
HAROLD L. VOLKMER, Missouri
HOWARD WOLPE, Michigan
BILL NELSON, Florida
RALPH M. HALL, Texas
DAVE McCURDY, Oklahoma
NORMAN Y. MINETA, California
TIM VALENTINE, North Carolina
ROBERT G. TORRICELLI, New Jersey
RICK BOUCHER, Virginia
TERRY BRUCE, Illinois
RICHARD H. STALLINGS, Idaho
JAMES A. TRAFICANT, JR., Ohio
LEE H. HAMILTON, Indiana
HENRY J. NOWAK, New York
CARL C. PERKINS, Kentucky
TOM McMILLEN, Maryland
DAVID E. PRICE, North Carolina
DAVID R. NAGLE, Iowa
JIMMY HAYES, Louisiana
DAVID E. SKAGGS, Colorado
JERRY F. COSTELLO, Illinois
HARRY JOHNSTON, Florida
JOHN TANNER, Tennessee
GLEN BROWDER, Alabama

ROBERT S. WALKER, Pennsylvania*
F. JAMES SENSENBRENNER, JR., Wisconsin
CLAUDINE SCHNEIDER, Rhode Island
SHERWOOD L. BOEHLERT, New York
TOM LEWIS, Florida
DON RITTER, Pennsylvania
SID W. MORRISON, Washington
RON PACKARD, California
PAUL B. HENRY, Michigan
HARRIS W. FAWELL, Illinois
D. FRENCH SLAUGHTER, JR., Virginia
LAMAR SMITH, Texas
JACK BUECHNER, Missouri
CONSTANCE A. MORELLA, Maryland
CHRISTOPHER SHAYS, Connecticut
DANA ROHRABACHER, California
STEVEN H. SCHIFF, New Mexico
TOM CAMPBELL, California
JOHN J. RHODES, III, Arizona

ROBERT C. KETCHAM, *Chief of Staff*
JOHN S. DOYLE, JR., *Chief Counsel*
CAROLYN C. GREENFELD, *Chief Clerk*
DAVID D. CLEMENT, *Republican Chief of Staff*

SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT

MARILYN LLOYD, Tennessee, *Chairman*

RICK BOUCHER, Virginia
TERRY BRUCE, Illinois
JERRY F. COSTELLO, Illinois
DOUG WALGREN, Pennsylvania
RICHARD H. STALLINGS, Idaho
JAMES A. TRAFICANT, JR., Ohio
HOWARD WOLPE, Michigan
TIM VALENTINE, North Carolina

SID W. MORRISON, Washington
HARRIS W. FAWELL, Illinois
STEVEN H. SCHIFF, New Mexico
LAMAR SMITH, Texas
JACK BUECHNER, Missouri

FRANCIS X. MURRAY, *Staff Director*
NANCY J. JEFFERY, *Professional Staff Member*
KITTY H. RISING, *Republican Special Assistant*

*Ranking Republican Member.

CONTENTS

WITNESSES

June 6, 1990: Page

Opening statement of Hon. Marilyn Lloyd, chairman, Subcommittee on Energy Research and Development 1

Opening statement of Hon. Sid Morrison, ranking Republican member, Subcommittee on Energy Research and Development 2

Hon. J. Michael Davis, Assistant Secretary for Conservation and Renewable Energy, U.S. Department of Energy, Washington, DC 9

Scott Sklar, executive director, Solar Energy Industries Association, Arlington, VA 39

Dr. Eric Hirst, corporate fellow, Oak Ridge National Laboratory, Oak Ridge, TN 51

Dr. D. Yogi Goswami, vice president, energy resources, American Society of Mechanical Engineers, Washington, DC 65

Dr. Robert A. Stokes, chief operating officer, Solar Energy Research Institute, Golden, CO 81

Dr. Donald L. Klass, president, Biomass Energy Research Association, Washington, DC 95

Randall Swisher, executive director, American Wind Energy Association, Arlington, VA 108

APPENDIX I: ADDITIONAL MATERIAL FOR THE RECORD

Dr. A. John Appleby, director, The Center for Electrochemical Systems and Hydrogen Research, Texas Engineering Experiment Station, The Texas A&M University System, College State, TX 121

Al Cobb, vice president for legislative and political affairs, Petroleum Marketers Association of America, Washington, DC 127

APPENDIX II: QUESTIONS AND ANSWERS FOR THE RECORD

Hon. J. Michael Davis, Assistant Secretary for Conservation and Renewable Energy, U.S. Department of Energy, Washington, DC 133

1991 DEPARTMENT OF ENERGY AUTHORIZATION

WEDNESDAY, JUNE 6, 1990

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT,
Washington, DC.

The Subcommittee met, pursuant to call, at 1:17 p.m., in Room 2325, Rayburn House Office Building, Hon. Marilyn Lloyd (chairperson of the subcommittee) presiding.

OPENING STATEMENT OF HON. MARILYN LLOYD, CHAIRPERSON, SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT

Mrs. LLOYD. The Subcommittee will come to order. I apologize. We've had votes and were somewhat delayed.

Before we begin our hearings, I do ask unanimous consent that the Subcommittee permit today's proceedings to be recorded and covered by the media, and if there is no objection, so ordered.

This afternoon we will be receiving testimony on the Department of Energy's Renewable Energy and Energy Conservation Research and Development programs. In addition to a budget overview, we will discuss several other areas of importance.

First, we are just extremely pleased that in 1989 the President signed into law H.R. 1216, the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989. The bill was originally introduced by Mr. Morrison and by me. It's a three-year authorization bill for selected renewable energy and energy conservation programs, and as part of our discussion today, we hope to receive a status report on the implementation of directives incorporated into the legislation.

And second, Assistant Secretary for Conservation and Renewable Energy, Mike Davis, has proposed a reorganization of both programs directed toward end users, so I certainly look forward to having Secretary Davis give us additional details on the reorganization and its impact on our ongoing activities. Then we also plan to ask our outside witnesses who are here today to give their assessment of the impact of the reorganization.

Finally, earlier this year the Department of Energy informed the Congress of 11 initiatives aimed at increasing energy efficiency and renewable energy sources. So clearly, the Department is refocusing its activities as they relate to conservation and renewable research and development, so I look forward to learning more about the initiatives and how they relate to the ongoing programs.

I now recognize the Honorable Sid Morrison for any opening statements he may have to make.

OPENING STATEMENT OF HON. SID MORRISON, RANKING REPUBLICAN, SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT

Mr. MORRISON. Thank you, Madam Chairman. I have a formal statement for the record.

I would comment informally that this Subcommittee has struggled with this issue area for some time—in fact, I think all of us have in the Congress, and in the Administration. I am pleased now, first of all, with Mike Davis, who is our star witness today, and his leadership he has provided the Department of Energy.

We also I think can be pleased, as you indicated, with the legislation that went through. It was our version of prioritizing the conservation and renewable energy programs as we saw them. Now the exciting thing is some new initiatives from downtown, as Mike will bring to us, almost "leapfrog" some of the things that we had in mind. So what a delightful process I think as America really wants to zero in on both conservation and renewable energy resources. So I look forward to the hearings.

[The prepared opening statement of Mr. Morrison follows:]

HON. SID MORRISON (R-WA)
OPENING STATEMENT

1991 BUDGET OVERVIEW: CONSERVATION AND
RENEWABLE ENERGY R&D PROGRAMS

JUNE 6, 1990

GOOD AFTERNOON. I AM DELIGHTED TO BE HERE AS THE SUBCOMMITTEE RECEIVES TESTIMONY ON THE DEPARTMENT OF ENERGY'S CONSERVATION AND RENEWABLE ENERGY R&D PROGRAMS.

I CAN RECALL THAT A YEAR AGO WHEN WE WERE IN A HEARING ON THIS SAME SUBJECT, WE WERE STRUGGLING WITH THE ADMINISTRATION'S BUDGET REQUEST. WE WONDERED HOW DOE COULD ACCOMPLISH THE R&D PROGRAM GOALS WITH A FUNDING LEVEL MUCH LOWER THAN THAT APPROPRIATED FOR THE PREVIOUS YEAR.

TODAY I HAVE GOOD REASONS TO FEEL MUCH MORE CONFIDENT ABOUT THESE PROGRAMS. FIRST OF ALL, WE ENACTED A 3-YEAR-AUTHORIZATION THAT PROVIDES CONGRESSIONAL GUIDANCE AND FUNDING

STABILITY FOR THESE PROGRAMS. SECOND, WE HAVE AN ASSISTANT SECRETARY, MIKE DAVIS, WHO IS HIGHLY CAPABLE AND DEDICATED TO DOING A GOOD JOB.

I HAVE BRIEFLY REVIEWED THE DOE BUDGET REQUEST AND THE PROPOSED NEW INITIATIVES TO INCREASE BOTH ENERGY EFFICIENCY AND RENEWABLE ENERGY SOURCES. I BELIEVE THAT IF CONSERVATION AND RENEWABLE ENERGIES ARE TO PLAY IMPORTANT ROLES IN OUR NATIONAL ENERGY STRATEGY, WE MUST ESTABLISH REALISTIC GOALS FOR THE NEAR-TERM, MID-TERM, AND LONG-TERM, SET PRIORITIES FOR THE PROGRAMS, AND TAKE PROPER STEPS TO ACHIEVE THESE GOALS. I THINK DOE'S NEW INITIATIVES ARE TRYING TO DO JUST THAT, AND I LOOK FORWARD TO HEARING SOME COMMENTS ON THESE INITIATIVES AS WELL AS OTHER RELATED ISSUES FROM OUR DISTINGUISHED WITNESSES TODAY.

Mrs. LLOYD. Thank you very much, Mr. Morrison.

Mr. Wolpe.

Mr. WOLPE. Thank you very much, Madam Chairman.

I want to first of all express my appreciation to you for convening this hearing. I believe the subject matter represents one of the most important programs in the Department of Energy. Conservation and renewable energy should be two cornerstones of any national energy policy that encourages both environmental protection and independence from foreign energy sources.

I believe that the hearing today will show that while we are heading in the right direction, taking some important steps in that direction, we still have a long way to go to realize the potential of renewable energy and conservation. Current trends indicate that oil imports will rise some 92 percent over the next two decades, and I think this statistic alone portends ill for our trade balance, for our national security, and for our environment. The unrealized potential of conservation and renewables can prevent this increased dependence on foreign oil and dirty fossil fuels in general.

In 1989, renewables provided nine percent of our domestic energy needs, more than nuclear power, but depending upon who you talk to, it is estimated that renewables can competitively provide today between 20 and 30 percent of our energy needs. So that's a lot of untapped potential. I take it that that is our purpose here, to assure that the Department's programs and funding levels will tap that potential.

I just want to raise one quick comment on the proposed reorganization, as I understand it, as it has been laid out. While I think that there may be a case that can be made for a more systematic approach based upon the end users, the needs of end users, as has been suggested here, I do have some concern that in the process we may well be degrading or downgrading basic renewable energy research.

Where there presently is in place a Deputy Assistant Secretary for Solar and Renewable Energy, I understand under the new formulation there will be a Director of the Office of Utility Technologies that will assume most of the responsibility for the solar renewable energy programs. I would be concerned that renewable energy programs could well get lost in that kind of reorganization. I would be interested in hearing the reactions of our witnesses today to that particular direction.

I am also concerned with the current level of funding for conservation and renewables. The budget for solar renewables was some $740 million for fiscal year 1990, it had plummeted to $82 million. I think that many people will agree that many promising projects were not just pushed to the back burner but were really given the deep freeze. I am encouraged that the President's 1991 budget requested an increase for solar energy, but in my mind, it is still not nearly enough.

That's all that I would like to offer at this point. I would ask unanimous consent, Madam Chairman, that the full text of my opening statement be entered into the record.

[The prepared opening statement of Mr. Wolpe follows:]

Statement of the Honorable Howard Wolpe
Committee on Science, Space, and Technology
Subcommittee on Energy Research and Development

Hearing on
FY 1991 Budget Request for Energy Conservation and
Renewable Energy Programs
June 6, 1990

I WANT TO THANK CHAIRWOMAN LLOYD FOR CONVENING THIS HEARING ON WHAT I BELIEVE IS ONE OF THE MOST IMPORTANT PROGRAMS OF THE DEPARTMENT OF ENERGY. THE SUBCOMMITTEE'S INTEREST IN CONSERVATION AND RENEWABLE ENERGY SIGNALS THAT THE CONGRESS IS AGAIN REALIZING THE IMPORTANCE OF THESE PROGRAMS TO THE LONG-TERM ENERGY HEALTH OF THE COUNTRY. THE DEPARTMENT, WITH ITS PROPOSED REORGANIZATION AND ELEVEN CONSERVATION AND RENEWABLES INITIATIVES, IS DEMONSTRATING FORETHOUGHT AND CREATIVITY IN ADDRESSING THE NATION'S FUTURE ENERGY NEEDS. I AM CONFIDENT THAT WORKING TOGETHER WE CAN MAKE MUCH PROGRESS.

CONSERVATION AND RENEWABLE ENERGY SHOULD BE TWO CORNERSTONES OF A NATIONAL ENERGY POLICY THAT ENCOURAGES BOTH ENVIRONMENTAL PROTECTION AND INDEPENDENCE FROM FOREIGN ENERGY SOURCES. I BELIEVE THAT THIS HEARING TODAY WILL SHOW THAT WE ARE HEADING IN THE RIGHT DIRECTION. BUT WE STILL HAVE FAR TO GO TO REALIZE THE POTENTIAL OF RENEWABLE ENERGY AND CONSERVATION.

CURRENT TRENDS INDICATE THAT OIL IMPORTS WILL RISE 92% OVER THE NEXT TWO DECADES. THIS STATISTIC ALONE PORTENDS ILL FOR OUR

TRADE BALANCE, OUR NATIONAL SECURITY, AND OUR ENVIRONMENT. THE UNREALIZED POTENTIAL OF CONSERVATION AND RENEWABLES CAN PREVENT THIS INCREASED DEPENDENCE ON FOREIGN OIL AND DIRTY FOSSIL FUELS IN GENERAL.

IN 1989 RENEWABLES PROVIDED 9% OF OUR DOMESTIC ENERGY NEEDS -- MORE THAN NUCLEAR POWER. BUT DEPENDING ON WHO YOU TALK TO IT IS ESTIMATED THAT RENEWABLES CAN COMPETITIVELY PROVIDE TODAY BETWEEN 20% AND 30% OF OUR ENERGY NEEDS. THAT IS A LOT OF UNTAPPED POTENTIAL. THAT IS OUR PURPOSE HERE: TO ASSURE THAT THE DEPARTMENT'S PROGRAMS AND FUNDING LEVELS WILL TAP THAT POTENTIAL.

REGARDING YOUR PROPOSED REORGANIZATION, I APPROVE OF THE SYSTEMATIC APPROACH TO CONSERVATION BASED UPON THE NEEDS OF END-USERS THAT YOUR REORGANIZATION WOULD PROMOTE. THE REORGANIZATION WOULD ALLOW THE DEPARTMENT TO ATTACK PROBLEMS IN NEW AND PRODUCTIVE WAYS. I DO HAVE A CONCERN, THOUGH, THAT IN THE PROCESS YOU WOULD BE DOWNGRADING BASIC RENEWABLE ENERGY RESEARCH. WHERE YOU CURRENTLY HAVE A DEPUTY ASSISTANT SECRETARY FOR SOLAR AND RENEWABLE ENERGY, YOU WOULD HAVE A DIRECTOR OF THE OFFICE OF UTILITY TECHNOLOGIES WHO WOULD ASSUME MOST OF THE RESPONSIBILITY FOR THE SOLAR AND RENEWABLE ENERGY PROGRAMS.

I AM WORRIED THAT RENEWABLE ENERGY PROGRAMS COULD GET LOST IN THIS ORGANIZATION AND THAT FUNDS APPROPRIATED FOR RENEWABLES COULD BE DIVERTED FOR OTHER PROGRAMS. I WOULD LIKE THE DEPARTMENT DURING THE COURSE OF THIS HEARING TO PROVIDE

ASSURANCES THAT THEY CAN NOT ONLY PROTECT RENEWABLE ENERGY PROGRAMS WITHIN THIS NEW ORGANIZATION BUT ALSO NURTURE THEIR GROWTH.

I AM ALSO CONCERNED WITH THE CURRENT LEVEL OF FUNDING FOR CONSERVATION AND RENEWABLES. 1980 THE BUDGET FOR SOLAR AND RENEWABLES WAS $740 MILLION. BY FY 1990 IT HAD PLUMMETED TO $82 MILLION. I THINK MANY PEOPLE IN THIS ROOM WILL AGREE THAT MANY PROMISING PROJECTS WERE NOT JUST PUSHED TO THE BACK BURNER BUT WERE GIVEN THE DEEP FREEZE. I AM ENCOURAGED THAT THE PRESIDENT'S FY 1991 BUDGET REQUESTS AN INCREASE FOR SOLAR ENERGY, BUT IN MY MIND IT IS STILL NOT NEARLY ENOUGH.

DESPITE HIGHER REQUESTS FOR SOME PROGRAMS, I FEAR OTHERS WILL GO BEGGING IN 1991. AS YOU MAY KNOW, IMPROVING INDUSTRIAL EFFICIENCY IS IMPORTANT FROM A POLLUTION PREVENTION PERSPECTIVE AS WELL AS FOR ENERGY CONSERVATION. NEW INDUSTRIAL PROCESSES CAN HAVE ENORMOUS PAYOFFS FOR BOTH THE ENVIRONMENT AND THE ECONOMY, YET THE FY 1991 BUDGET PROPOSES A $10 MILLION CUT IN INDUSTRIAL PROCESS EFFICIENCY RESEARCH. I WOULD LIKE TO HEAR THE DEPARTMENT'S THOUGHTS ON THIS CUT AS WELL AS ON THE REST OF THE CONSERVATION AND RENEWABLES BUDGET DURING THIS HEARING.

I THANK THE CHAIRWOMAN FOR HER INDULGENCE AND LOOK FORWARD TO HEARING FROM THE WITNESSES.

Mrs. LLOYD. Thank you very much, Mr. Wolpe.

Mr. Buechner.

Mr. BUECHNER. No thank you, Madam Chair. I have no opening statement.

[The prepared opening statement of Mr. Costello follows:]

OPENING STATEMENT BY U.S. REPRESENTATIVE JERRY F. COSTELLO, ILLINOIS

Madam Chairman, today we are convened to hear testimony on the Department of Energy's Fiscal Year 1991 budget request for Conservation and Renewable Energy programs. We have a wide range of witnesses representing the federal government, research institutions, and private sector organizations.

As we consider the problems of increased energy demand, it is important to recognize contributions that can be made by renewable energy.

Madam Chairman, I thank you for calling this hearing and I anticipate some interesting and relevant commentary by our distinguished witnesses.

Mrs. LLOYD. Well, our first witness is the Honorable J. Michael Davis, Assistant Secretary for Conservation and Renewable Energy at the Department of Energy. This is your first time and we extend you a warm welcome. Please proceed with your testimony.

STATEMENT OF HON. J. MICHAEL DAVIS, ASSISTANT SECRETARY, CONSERVATION AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Mr. DAVIS. Madam Chairman, thank you, Members of the Committee. I am pleased to be here to respond to your questions concerning our reprogramming request, our reorganization, and also implementation of Public Law 101-218.

First, let me discuss the approach that we used for the reorganization as well as the reprogramming. In the past, the Department's focus has clearly been on long-term, high-risk, potentially high payoff research. Without neglecting the long-term activities—because I think they are fundamentally important at the technology base—I personally believe that we need more effort in the mid-term and the near-term. My own personal business experience suggests that we've got an awful lot of products and capabilities, both in terms of energy efficiency and renewables, that are available for the market and need to be assisted.

In evaluating our budget and mission, I basically approached it with the following themes: first, the theme of end use. We do a lot of things in our economy by end use. We regulate by end use, we invest by end use. It's a topic that's much more familiar and understandable to our industrial sector—and a sector that we have to build a much better relationship with.

I think it's also important to look at the time frames, not just long term, but also mid-term and near-term. If we are trying to be successful with a better relationship between our business and industrial sector and the Government, I think we need to look at immediate things we can do as well as the longer sorts of things. And I think as we look at the competition we have from overseas, we see many, many examples of a much better Government-industry relationship that focuses certainly more than on just the long term.

With the end use in mind and with the time frame in mind, then we will cut that by energy supply, energy demand, and infrastructure, those three approaches. That's how we think about our organization and that's how we think about our budget. I think the or-

ganization is substantially more user friendly. Keep in mind who our customers are. I think our customers are largely in the private sector. I think that's the group that actually has to make the investments to make progress on these topics, and I think it's important that we be able to line up efficiently with that group.

The reorganization you can see by structure. It's a little difficult for me to see from here. But what we basically did I think was take a good focus that was historically on the conservation side—in other words, a focus by sector, transportation, buildings and industry—and we extended that to a fundamentally important addition called utilities, utilities that serve those sectors. And then we had another great opportunity within our own organization that I think had largely been ignored for years called State and local programs. That group, that can actually connect with every State government in this country, that group that is plugged into the application, the very near-term application of technologies that provide substantial benefit.

So we have not two Deputy Assistant Secretaries. We now have five. We have kept that level throughout the organization. Some would say we basically pounded the organization flat. There is substantially more opportunity for advancement within the organization, there is substantially more opportunity for ideas to flow forward, and there is a heavier management structure, if you will, by sector, that consider not just supply opportunities in a vacuum, not just energy efficiency or demand opportunities in a vacuum, but both of them as to they serve a sector.

I would like to introduce a couple of those people. My Deputy, Reid Detchon, who is doubling as a chart. We have a couple of other people in the room that you know well. Al Streb was Deputy Assistant Secretary for Conservation and now is Deputy Assistant Secretary for Industry. Bud Annan, who is standing in today for Dr. Bob San Martin, on the renewables area. Dr. San Martin is now Deputy Assistant Secretary for Utility Technology. Al Chesnes, who was formerly an office director, is now Deputy Assistant Secretary for Transportation. And, let's see. We have Gary Moore with us today, who is running my Office of Planning and Assessment. We didn't have that capability at the top of the organization before. There was really no way of setting common challenges, if you will, within the organization, or to assist in the strategic planning of various topics, so we think we've added to that capability. John Millhone, who you know from the buildings area, now is Deputy Assistant Secretary for Buildings. And Frank Stewart is the Deputy Assistant Secretary for Technical and Financial Assistance.

That's a much more able management structure. It's much broader, and it does allow, I think, a better view of what these technologies can contribute.

When I assumed this job, in effect, what I had was 300 projects in energy efficiency and about the same number of projects in renewable technologies. I certainly had a clear indication from you all—you've been very positive and you've essentially pulled these programs along, and I wouldn't say that the Department of Energy has met you as aggressively and as fully as a partner as they could in the proposition. So one of the things I had to do was see how we

might be able to expand our constituency both in the private sector and within the Department of Energy and help people see the real value inherent in these technologies.

Mrs. LLOYD. Maybe the audience would like to see the chart as well. If you would sort of turn the easel around toward the audience, they would appreciate it as well. Thank you.

Mr. DAVIS. I would take, for instance, transportation as an example. We made a major increase this year in what some people refer to as biomass. Now, that typically had to be presented as renewable energy before, and I know there are some concerns about we've lost some of these titles. And if you support biomass for simply biomass, it might be a little hard to really come to grips with how important are the programs. But if you look at it in terms of new sources of energy supply for the transportation sector, first starting with the difficulties that challenge the transportation sector in terms of our fuels, in terms of how much we import, you begin to see that alternative liquid fuels are very, very important—in fact, I believe substantially more important than we've given them credit or that we could actually see treated simply as a renewable technology. So I think, across the board, both on the renewable side of the program, on the energy efficiency side of the program, we are in a much better position to put these technologies in perspective and bring them forward at more appropriate levels. So that drove a lot of our thinking.

The fiscal year 1990 appropriations, as I looked at those, I thought they did form the basis for some focusing. I think we were in a situation where there was lots and lots of good ideas but maybe we hadn't focused our money well enough on the really outstanding set of a whole bunch of good ideas to make progress, and again to bring out the merit that I think is inherent in these programs. So we attempted to focus a budget of roughly $300 million and use some near-term activities, which are the primary basis for our initiatives, to bring some of that technology—to maybe bring it more into play, to emphasize more how valuable and how much contribution is actually there, to kind of reinforce the Department's commitment to these technologies more than just long term.

I really think that the eleven-and-a-half million total from this reprogramming doesn't represent any kind of distortion relative to $300 million basically of research. I don't think that was distorting the long-term mission.

We requested five million from the Interior Appropriations Subcommittee for six initiatives in energy efficiency, and six-and-a-half million from the Energy and Water Development Appropriations Subcommittee for four initiatives.

We didn't start out with a magic number of initiatives, either. We simply put out a call, went out through the organization and went out through the field structure and said basically bring us your ideas. There wasn't a limit established in advance; there weren't criteria established in advance. It was okay, folks, you've been bottled up for a while. Let's put on our thinking caps and see what kind of ideas much surface.

Many of the initiatives that came forward actually dealt with organizational shape and opportunity and better ways to work within

the Department, better ways to work within the field structure, pointing out opportunities and resources that exist that may not be obvious. So the ideas that came forward were varied, and we selected a number that we thought were close enough to existing programs that, frankly, whether or not the reprogramming moved efficiently or not, you all have left us with certain authorities to reprogram within limits, and, in fact, we'll do that within the limits already established. If we can be more aggressive than that, certainly we would like to and that's the basis of our request.

The initiatives that we have proposed on the renewable side, the first one is the manufacturing technology for photovoltaics. We thought, if we were going to be more aggressive in our 1991 request—and in renewables we are; it's about 27 percent above last year's appropriation—that we ought to kind of set the trend for that in our current fiscal year, and that would be a good message to send senior DOE management and also to OMB. So we thought we would try and set the direction in fiscal year 1990 and not wait until 1991.

The manufacturing technology for photovoltaics initiative also is a very close parallel to what you all had in mind with the joint ventures, because it will be industry driven and it will address the issue of trying to reduce the cost of those products.

Solar detoxification of hazardous wastes, roughly another $1.8 million; cost-competitive ethanol fuels, approximately $2 million; and a start on the next research laboratory at the Solar Energy Research Institute, operating in basically facilities leased as office space. It's not a particularly good work environment to do the kind of research that's necessary on these technologies, and we think it's well time to move that facility forward. That's reflected in both 1990 reprogramming and also our 1991 request.

The energy efficiency initiatives, these are certainly near-term focus, but we've already begun to get some progress on some of these within our resources.

Accelerated building guidelines and standards. If you put up a building, it's a 50-year decision. And before we make those 50-year decisions, we have to give more attention to the ramifications.

Relighting commercial buildings, integrated resource planning—I would like to touch on that particular initiative at little bit greater length. If you look at the future projections for energy demand in the country, and particularly electricity, and our ability to actually build plants of any kind, to build power lines of any kind, then you look at the amount of electricity that flows to buildings, which is about two-thirds of all the electricity we generate, buildings are a major target to avoid the use of electricity. To do that, we have to have an excellent and substantially expanded relationship with the electric utility industry in this country. It's got to improve, it's got to improve quickly and be effective.

We believe that the activities underway here allow us to work with the utility sector, allow us to work with the regulatory sector for those utilities, and maybe clear the way for substantial utility investment in these technologies in a way that is indeed profitable to the utilities. It doesn't take a great deal of money on our point, but it's a fundamentally important activity.

Relighting Federal buildings, we have been after that Federal marketplace for a long time. I think there was a little bit of defying it, how could we possibly do anything with this tiny little bit of money. But I would report to you that we have initial indications of interest here in the local area, both from GSA and a local utility, that would bring $20 million to that activity in the next year, year-and-a-half, just in the Washington-Baltimore area. We'll provide some expertise in the form of paying the cost of engineering skills, both public and private sector capabilities, and put that together with GSA and the utility company, and I think we'll make some progress. But the majority of that money will actually be spent outside our budget, as it should be.

Energy from municipal waste is another topic that we want to look at. We think that's a major resource. It's certainly a major problem for almost all municipalities across the country—what do you do with it. If you do burn it, what are the results of burning it? Can you burn it safely? What's the proposition in terms of tradeoffs between recycling and combustion, because we certainly can't continue to landfill it. We have to make some choices on those topics.

What we have tried to do with these initiatives is simply set a direction of positive thinking and also stress that while we need a certain amount of money in our budget to do it, what we really need is the right attitude and the right relationship with the private sector. If we do that, we get substantial leverage both within other Federal parts of the budget as well as leveraging money for the private sector.

Turning to Public Law 101-218, we believe that the intent—that we are now consistent with the intent of that piece of legislation. The bill became law in December, it became law after our 1991 budget request was, in fact, closed and brought forward. Aside from that, though, we have moved forward with the establishment of an advisory committee, a charter for the joint venture advisory committee has been drafted, a draft solicitation for the joint venture is also in the process of being prepared, and consistent with congressional actions in 1991 appropriations, I anticipate that the draft solicitation would be reviewed by the advisory committee and be ready for public comment by the required date of September 30, 1990.

There are a couple of other activities, one other at least that I would mention that I think is absolutely in this spirit of the joint venture approach, and that's the metals initiative. There may be more questions on that later. But it's another example, I think, of a very positive relationship between the Government and industry in a very important area.

I think we're moving towards a balanced approach. I think we're moving in a direction where we can really assess the merits of both energy efficiency and renewable technology in a more fundamental way than we have in the past. I believe, if we do that, in essence, put ourselves in a position to compete with all energy technologies, whether they be energy supply technologies or whether they be energy demand reduction technologies, that we'll compete favorably. It is certainly our intent to be aggressive on that topic.

Thank you.

[The prepared statement of Mr. Davis follows:]

Statement of J. Michael Davis

Assistant Secretary, Conservation and Renewable Energy

U.S. Department of Energy

to the

Committee on Science, Space and Technology

Subcommittee on Energy Research and Development

U. S. House of Representatives

June 6, 1990

Madam Chairman and members of the Committee, I am pleased to appear before you to respond to your questions regarding the reprogramming of $11.5 million of FY 1990 appropriations, the reorganization of the Office of Conservation and Renewable Energy, and the implementation of P.L. 101-218, the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989.

Let me first discuss the philosophical approach upon which the reorganization and the reprogramming is based. In past years, the Department's focus has been almost exclusively on high-risk, long-term research. Without neglecting long-term research, we determined that a more balanced mixture of near-, mid- and long-term research would better meet our country's needs. A similar view, I believe, underlies the objectives of P.L. 101-218.

In evaluating our budget and mission, I have used these organizing themes:

End Use -- The application of our technologies to industry, buildings, transportation or utilities.

Time Frame -- The availability of our technologies in the near-, mid- or long-term.

Supply/Demand/Infrastructure -- The usefulness of our programs to develop additional energy supplies, to reduce energy demand, or to reduce institutional barriers that constrain the use of our technologies.

The goal of our reorganization was to create an end-use oriented structure to address these issues and accelerate market penetration by new technologies. I believe the structure I am about to describe accomplishes this.

REORGANIZATION OF THE OFFICE OF CONSERVATION AND RENEWABLE ENERGY

At the time of my appointment as Assistant Secretary for Conservation and Renewable Energy (CE), I saw the need for a thorough review of the existing CE management structure, its mission and functions, legislative derivation, operational procedures, resources and personnel. The need for this review was underscored by:

1. A new emphasis on applications research and development activities, while continuing long-term, high-risk research in the CE mission;

2. A new national sensitivity to the environmental effects of energy production and consumption;

3. An emerging National Energy Strategy that identifies improved energy efficiency as a cornerstone of policy, and renewable energy as an essential future supply option;

4. Direction by the Secretary to emphasize development of research centers of excellence and promotion of programs that enhance educational opportunities.

The review was conducted by a special internal task force of CE professional staff over a period of two months. My conclusion in response to the task force recommendations was that CE could better accomplish its mission through a structure comprised of four major research areas directed to the end-use sectors: Utilities, Industry, Transportation and Buildings. A cross-cutting component would provide the necessary technical and financial assistance and encourage technology transfer. In addition, we concluded that an office for planning and assessment was needed to develop end-use strategies more efficiently and ensure that CE research activities reflect thorough consideration of the related technical, economic and environmental factors involved. These organizational components are shown in Attachment 1. Program activity crosswalks from the new organization elements to the major program activities of the old organization are shown in Attachment 2.

All present CE staff can be effectively utilized in the new organization without adverse impact on personnel. The structure also offers substantial individual career growth opportunities for CE personnel and provides flexibility for management if energy efficiency and renewable energy technologies receive the future visibility and emphasis we expect.

ENERGY EFFICIENCY AND RENEWABLE ENERGY REPROGRAMMING INITIATIVES

Fiscal Year 1990 appropriations form the basis for sustaining core research programs in energy efficiency and renewable energy technologies. Building on that base, DOE has requested Congressional approval to reprogram $11.5 million to fund ten high-priority energy efficiency and renewable energy initiatives, many of which were supported by public testimony delivered at NES hearings. The reprogramming request includes $5.0 million from the Interior Appropriations Subcommittee for six initiatives in energy efficiency technologies and $6.5 million from the Energy and Water Development Appropriations Subcommittee for four renewable energy initiatives. An additional initiative in the hydropower area did not require reprogramming.

The reprogramming funds included in the request are a combination of FY 1989 carryovers, prior deobligations, and sequestered FY 1990 funds returned to DOE but not included in core research

program planning for this fiscal year. These funds are to be leveraged to start a major six-year effort, which is also represented in the President's FY 1991 Budget.

Let me briefly summarize the initiatives for you.

RENEWABLE ENERGY INITIATIVES:

Manufacturing Technology for Photovoltaics, $1.7 million -- This initiative will start an intensive effort with the PV industry to improve current manufacturing and production processes. The activities will include a competitive program to provide cost-shared technical assistance to our industrial partners to develop improved manufacturing techniques.

Solar Detoxification of Hazardous Wastes, $1.8 million -- Existing research will be accelerated to improve the application of this exciting new technology to a variety of chemical wastes. In addition, site experiments will be conducted at contaminated locations within the DOE field complex, and cooperative programs will be developed with other government agencies working in the hazardous waste area.

Cost-Competitive Ethanol Fuels, $1.98 million -- Current DOE research programs in alternative fuels will be expanded to include cost-shared joint ventures with industry to reduce the cost of ethanol production from domestic non-food resources. Specific efforts will be made to coordinate other federal programs such as the DOE/Department of Agriculture research on non-food energy crops such as plants and trees.

Solar Energy Research Institute, $1.0 million -- A new laboratory is needed to replace currently inadequate facilities. Construction of this facility signals DOE's commitment to expand the contribution of renewable energy to our energy future. This portion of funding will complete final design activities and lead directly to the DOE FY 1991 line-item request of $4.5 million to begin construction on a structure to house materials science research in photovoltaics.

ENERGY EFFICIENCY INITIATIVES:

Accelerated Building Guidelines and Standards, $0.6 million -- DOE will promote the implementation of its voluntary standards for residential and commercial buildings and encourage States and localities to incorporate them into

their building codes by working with building trade and technical associations to provide training and support to architects and engineers.

Relighting Commercial Buildings, $0.4 million -- DOE will examine options for improving the Energy Policy and Conservation Act in the area of incandescent and fluorescent lighting in commercial and industrial buildings.

Integrated Resource Planning, $0.7 million -- DOE will work with the Federal Energy Regulatory Commission to encourage equal treatment of energy supply and demand reduction options, with appropriate return on investments. The objective is to make efficiency as profitable for electric utilities and their customers as capacity expansions.

Relighting Federal Facilities, $0.8 million -- Energy efficiency teams of federal engineers and design specialists will conduct audits to identify and target buildings for retrofitting with today's more efficient lighting technologies. Savings will be analyzed and optimal financing strategies designed that will include cost-sharing with utilities.

Energy from Municipal Waste, $2.0 million -- DOE plans joint ventures with industry to characterize the emission products

from combustion of all major municipal waste streams. DOE will also collect and publish data for the public and decision-makers on the energy benefits of landfill recycling and waste combustion technologies.

Energy Analysis and Diagnostic Centers, $0.5 million -- DOE will expand its 13 centers at engineering schools by three schools this year and another three schools next year. These centers conduct limited energy efficiency audits for small and medium-sized manufacturing firms.

In summary, these initiatives set a standard of Federal leadership in energy efficiency and renewable energy. They represent choices and focus -- choices about the most promising opportunities to pursue, and focus on those that will have the highest payoff. They build on existing successful research programs and are responsive to testimony gathered across this country in the National Energy Strategy hearings.

IMPLEMENTATION STATUS OF P.L. 101-218, THE RENEWABLE ENERGY AND ENERGY EFFICIENCY TECHNOLOGY COMPETITIVENESS ACT OF 1989.

The purpose of the Renewable Energy and Energy Efficiency Technology Competitiveness Act is consistent with the programs and planning we have initiated at the Department.

This bill became law in December of last year, well after our funding plans for FY 1991 had been finalized. However, because our goals are so similar, I am able to report significant strides in complying with both the spirit and the letter of this law. Briefly, let me provide you some examples.

Establishment of Advisory Committee -- A charter for the Joint Venture Advisory Committee has been drafted, and members will be invited to serve in accordance with the guidelines established by the Act.

Joint Venture Draft Solicitation -- A draft solicitation encompassing each of the technologies required by the Act is being prepared now. Consistent with Congressional actions on FY 1991 appropriations, I anticipate that this draft solicitation will be reviewed by the Advisory Committee and ready for public comment by September 30, 1990.

Manufacturability of Photovoltaics -- This initiative is an example of how the work already underway in CE parallels the goals and direction listed in the Act. We have expanded and accelerated a DOE-funded research program investigating ways to reduce production co: s of photovoltaics (PVs). Findings from this research program have identified ways to significantly improve production lines for PV products, with cost savings ranging from 20% to 50%. Our next steps with

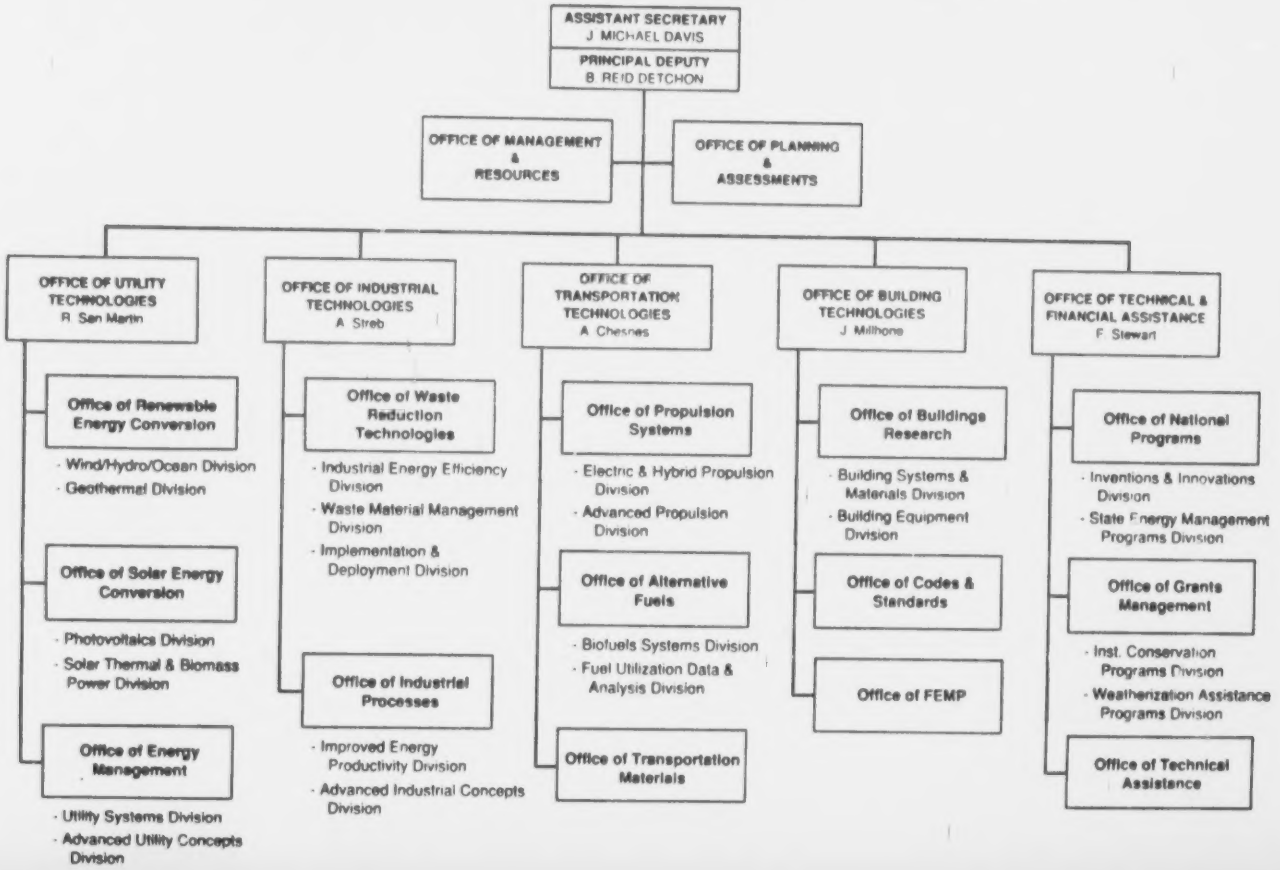
industry in this initiative will involve applying these findings to production lines.

Metals Initiative -- DOE is engaged in a $30 million pilot project with the American Iron and Steel Institute (AISI) to combine the current three-stage steelmaking process (coke, iron, steel) into one step. DOE is providing 70% of project funding, with the rest provided by AISI members. Widespread use of this "leapfrog" technology would reduce environmental problems associated with the cokemaking process, reduce the size of steel plants that can be run economically, and reduce capital requirements for building and operating a plant.

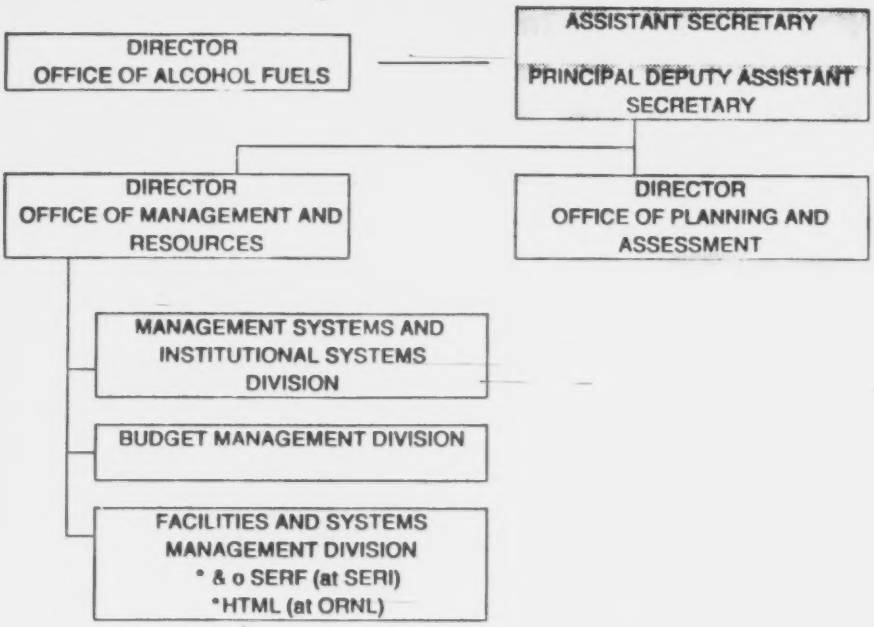
Madam Chairman, in conclusion, we are proposing a balanced, aggressive program in renewable energy research and development. There are some very exciting initiatives under way. We are refocusing our programs to play the key role they deserve in our emerging National Energy Strategy. Together with our program in energy efficiency, we are investing in critical components of our energy future. As we assess the relative benefit of these varied components, our understanding of their interrelationship will continue to improve with each succeeding year. Your support in providing the flexibility needed to manage the program is critical in this regard.

ATTACHMENT 1.—OFFICE OF CONSERVATION AND RENEWABLE ENERGY ORGANIZATION CHART

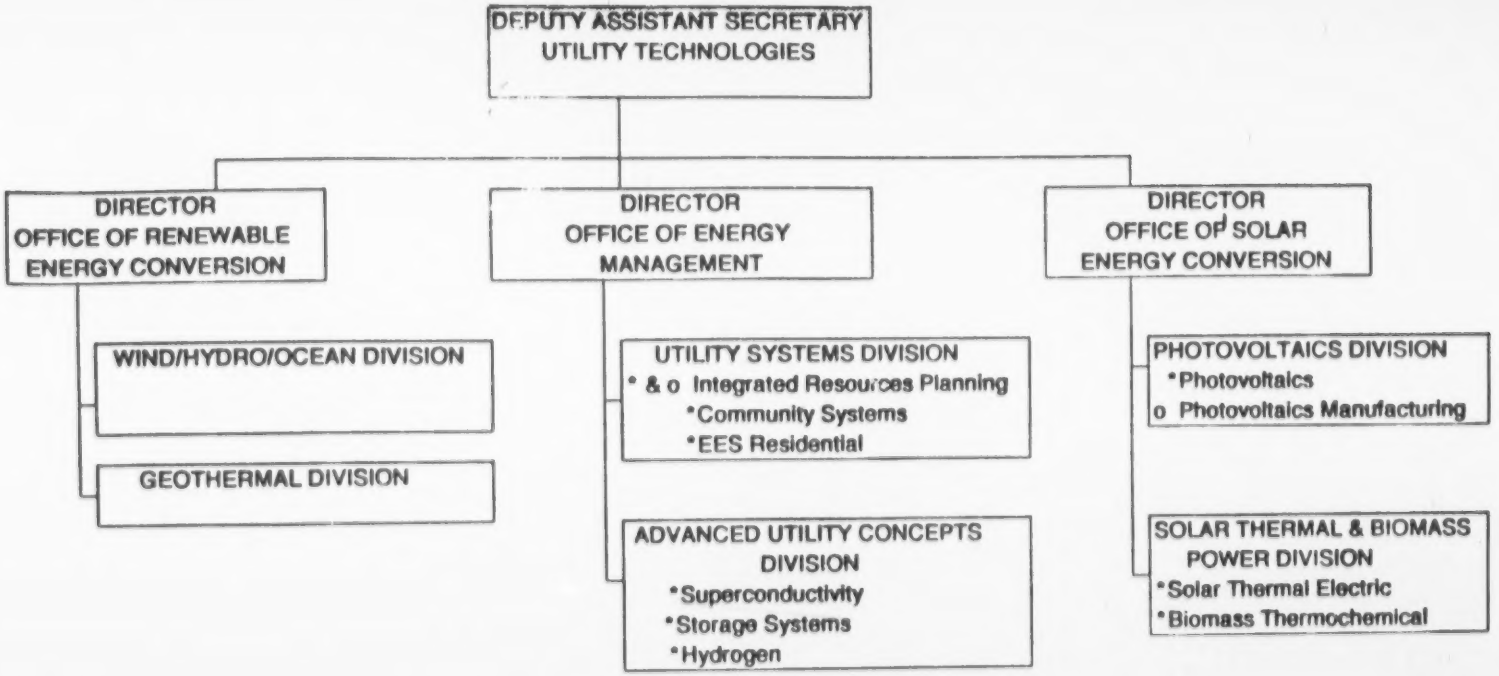
CONSERVATION AND RENEWABLE ENERGY


ASSISTANT SECRETARY
J. MICHAEL DAVIS
PRINCIPAL DEPUTY
B. REID DETCHON
OFFICE OF MANAGEMENT & RESOURCES
OFFICE OF PLANNING & ASSESSMENTS
OFFICE OF UTILITY TECHNOLOGIES
R. San Martin
Office of Renewable Energy Conversion
- Wind/Hydro/Ocean Division
- Geothermal Division
Office of Solar Energy Conversion
- Photovoltaics Division
- Solar Thermal & Biomass Power Division
Office of Energy Management
- Utility Systems Division
- Advanced Utility Concepts Division
OFFICE OF INDUSTRIAL TECHNOLOGIES
A. Streb
Office of Waste Reduction Technologies
- Industrial Energy Efficiency Division
- Waste Material Management Division
- Implementation & Deployment Division
Office of Industrial Processes
- Improved Energy Productivity Division
- Advanced Industrial Concepts Division
OFFICE OF TRANSPORTATION TECHNOLOGIES
A. Chesnes
Office of Propulsion Systems
- Electric & Hybrid Propulsion Division
- Advanced Propulsion Division
Office of Alternative Fuels
- Biofuels Systems Division
- Fuel Utilization Data & Analysis Division
Office of Transportation Materials
OFFICE OF BUILDING TECHNOLOGIES
J. Millhone
Office of Buildings Research
- Building Systems & Materials Division
- Building Equipment Division
Office of Codes & Standards
Office of FEMP
OFFICE OF TECHNICAL & FINANCIAL ASSISTANCE
F. Stewart
Office of National Programs
- Inventions & Innovations Division
- State Energy Management Programs Division
Office of Grants Management
- Inst. Conservation Programs Division
- Weatherization Assistance Programs Division
Office of Technical Assistance

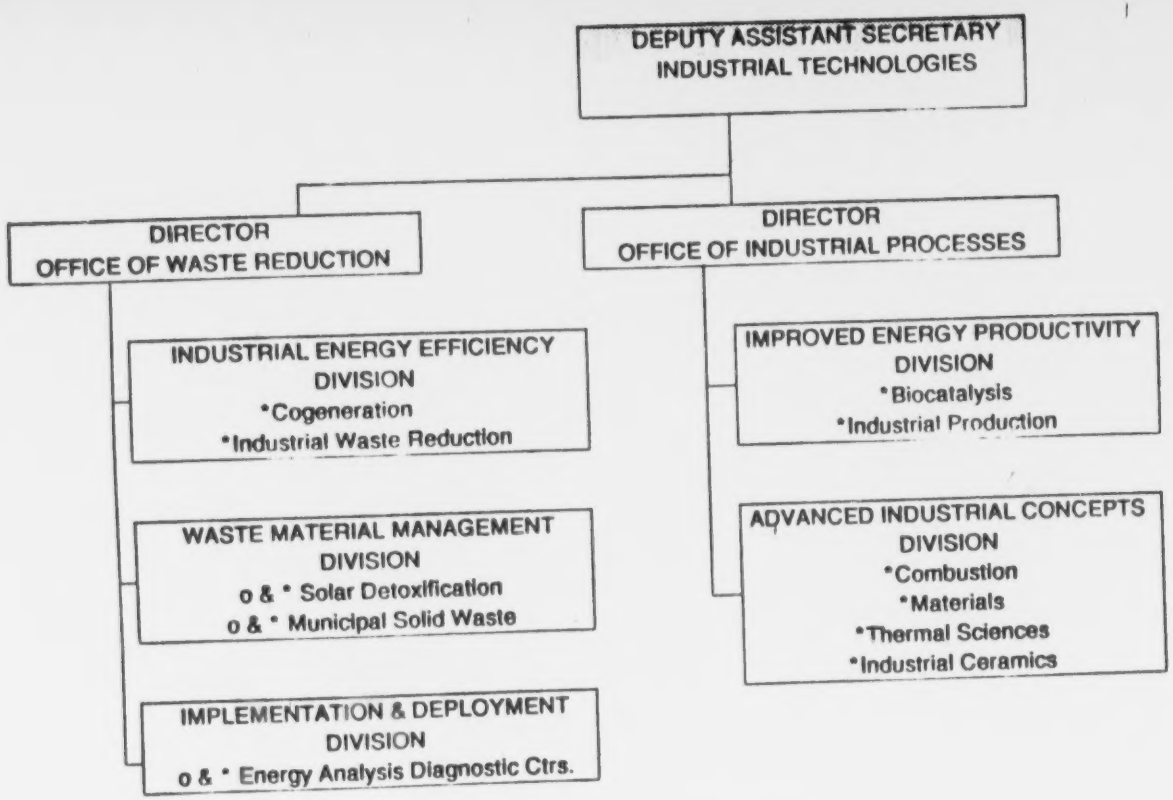
ATTACHMENT 2.—OFFICE OF CONSERVATION AND RENEWABLE ENERGY PROGRAM ASSIGNMENTS



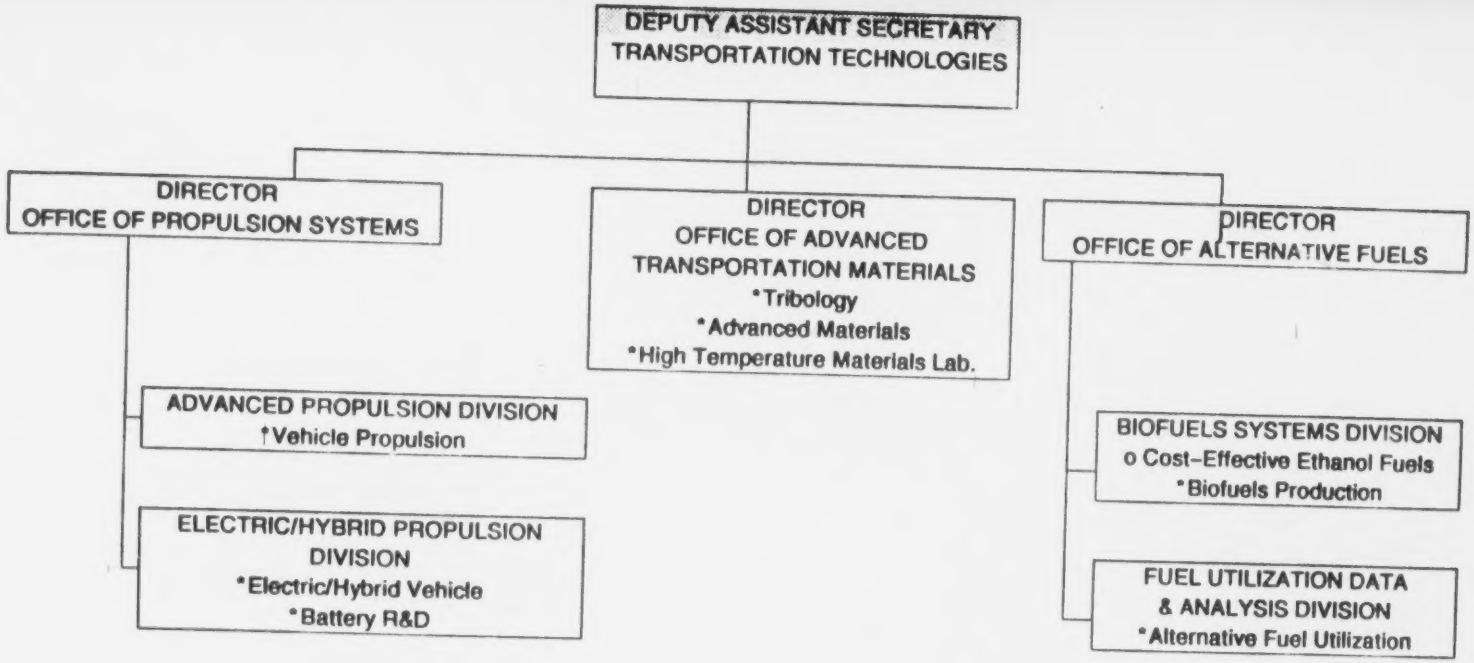
Sheet 1 of 6
* Program Relationship
o Initiative Assignment



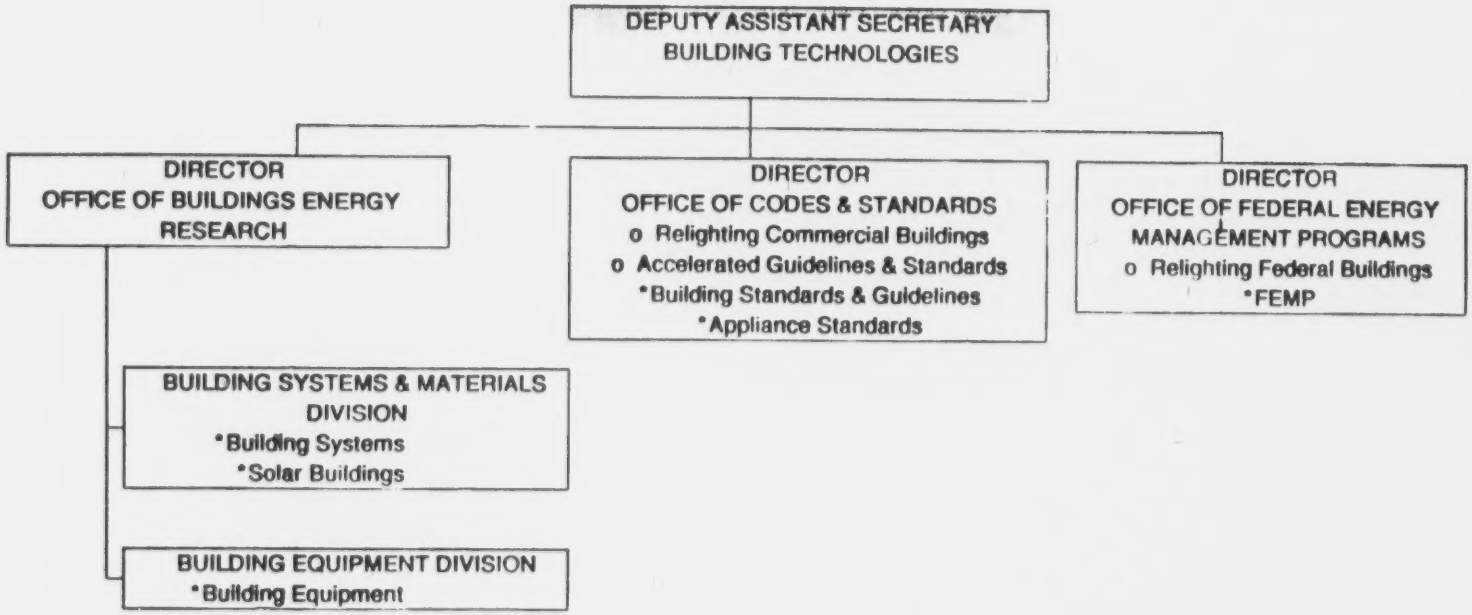
Sheet 2 of 6
* Program Relationship
o Initiative Assignment



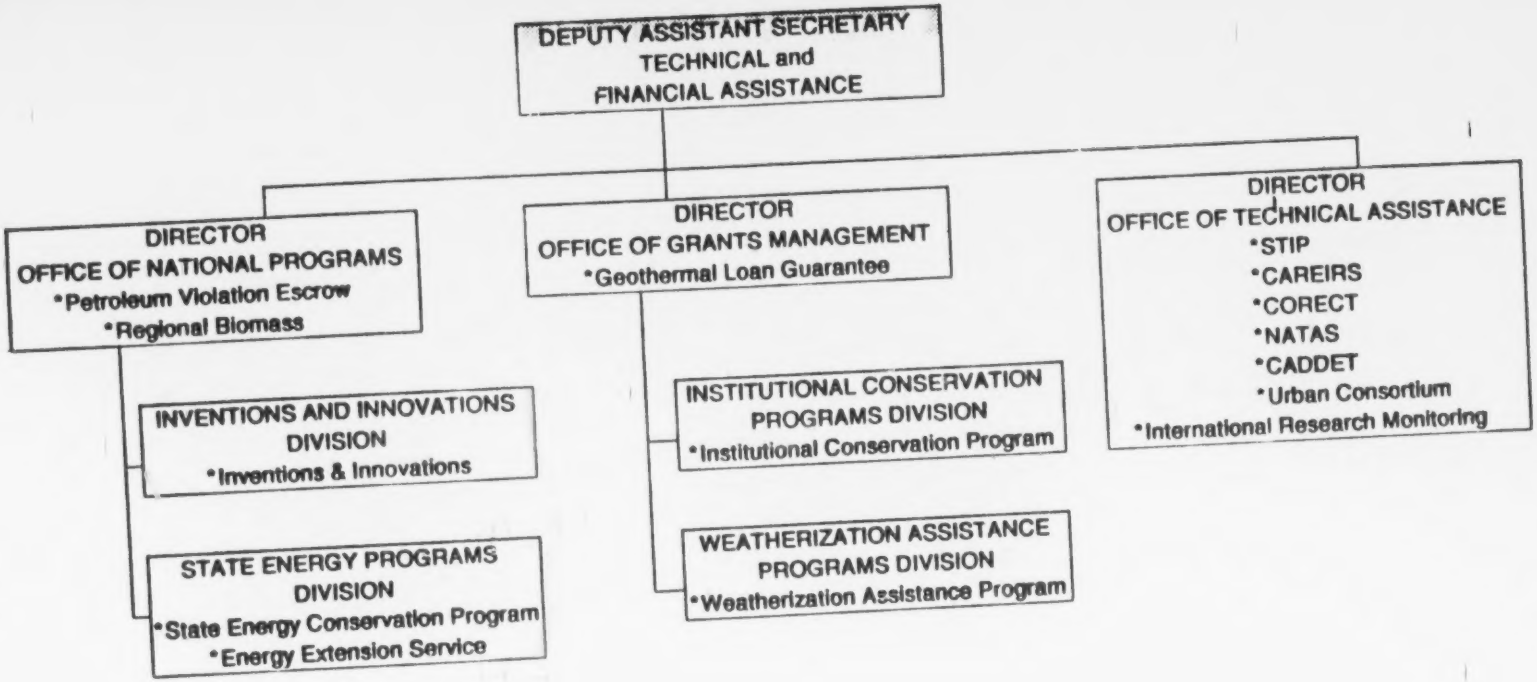
Sheet 3 of 6
• Program Relationship
o Initiative Assignment



Sheet 4 of 6
* Program Relationship
o Initiative Assignment



Sheet 5 of 6
* Program Relationship
o Initiative Assignment



Sheet 6 of 6
* Program Relationship
o Initiative Assignment

Mrs. LLOYD. Thank you for your excellent testimony. I'm very impressed with your charts, your organization, and certainly your enthusiasm and your goals.

It just occurred to me, Mr. Morrison, as we look into the chart, it was just about eight years ago there were efforts underway to dismantle the Department of Energy, and this is our flow chart for one——

Mr. MORRISON. They look like building blocks to me.

Mrs. LLOYD. We certainly applaud your efforts, but we have come a long way in the last eight years in our concern for renewable sources of energy.

Two of the initiatives you propose this year are of special interest to me—the energy from municipal waste and the solar detoxification of hazardous wastes. I believe that the energy from municipal wastes is an issue that may be of great importance to metropolitan areas and certainly to the United States as a whole. What we do with the huge amount of waste that's generated has become a difficult problem for so many of our cities. I imagine every Congressional district in the United States has this concern. So producing energy from waste seems to me like a very wise solution to a continuing problem.

And the second area of solar detoxification of hazardous wastes certainly is a real breakthrough in both the use of solar energy and the cleaning up of already contaminated sites. Both of these initiatives can certainly be good alternatives to incineration and the pollution problems that are associated with it. I believe that utilization of new technologies are a prudent way to spend limited resources, so I'm pleased that the Department has given these two new innovative ideas the attention that they deserve.

So my question to you, Mike, does the Department of Energy have experience with facilities that do produce energy from municipal wastes?

Mr. DAVIS. What has our experience been?

Mrs. LLOYD. What's it been and what have you done in this area of technology development so far?

Mr. DAVIS. On this particular initiative, what we've done so far is try and do a better cataloging, if you will, of what the issues really are surrounding landfills, and where they are and how much the number is decreasing. I think it's gone from something like 6,000 down to 2,000.

The treatment of municipal waste and the treatment of sewage basically seem to be the two biggest problems facing most municipalities. If you look at the energy they actually use, the operating energy that most cities use, most of the energy flows to those issues. We think right now there's a great amount of uncertainty as to whether you continue to bury it, whether you burn it, or basically whether you recycle it.

Now, we may be headed in the direction here I'm a little bit concerned about if we would simply mandate recycling. There clearly looks to me like there's opportunities—and again, I think the private sector can make the choice between how much is recycled and how much is burned. It's our thinking initially that you can burn municipal waste, you can combust it. In most cases, if you control the temperature of that combustion, which you do by co-firing

with, say, natural gas or coal, that you can burn it and you know what the results are going to be. In other words, you can control the combustion. So that what goes up the stack is not a threat. We can tell what is actually going up the stack. We need more data on that to be comfortable and confident that we——

Mrs. LLOYD. So you really don't have the experience right now to move forward?

Mr. DAVIS. Well, we think the whole proposition is moving forward, and we're afraid that it'll move forward and we'll decide that we simply can't burn municipal waste before we really looked at it and said can you, in fact, and if you do, how do you burn it, such that it is safe.

The markets that we've got now certainly can't accept the recycling opportunities. And if you look at some of these things from an energy point of view, there may be substantially more energy recaptured by actually burning it cleanly than recycling. There also might be other opportunities, rather than recycling as we know them, again of converting some of the municipal waste back to liquids that are either feedstocks or even potential fuels for transportation. So there's an awful lot that can be done, and before we automatically decide, or before we decide in advance of knowing some of these things, our view is that we need to very aggressively sort that out. That's why we're trying to get started.

Mrs. LLOYD. It is your opinion that there is still a lot of unanswered questions and lessons to be learned?

Mr. DAVIS. Yes, there is.

Mrs. LLOYD. What size city—and we know that these facilities cost money. What size city or county do—what sizeable amount of waste do we need to make this sort of economically attractive, do you feel?

Mr. DAVIS. I think it'll depend on the kind of each local situation. You know, we've got an example right down here in Lorton, where a facility is recently coming on line, at 3,000 tons a day. But that's driven by a $25 a ton tipping fee. That certainly is of paramount importance to the economics of the overall project.

The second issue that I think is quite important is the availability of, say, tax-free municipal bonds. So the combination of how expensive it is to get rid of the waste and the availability of different kinds of financing schemes probably are the controlling issues as opposed to simply size. I could imagine a municipal waste facility for a community of 50-100,000 people certainly being a good possibility.

Mrs. LLOYD. What kind of problems are created for this type of facility with either air emissions or ash disposal?

Mr. DAVIS. I think those are the two primary uncertainties. I use this example a lot, but I would encourage everybody to go down and look at that facility at Lorton. It's a much better neighbor than the landfill it's adjacent to, a much better neighbor. And they believe—and they have a continuous monitoring process so that they know what's going up the stack. They think that's comparable to what would go up the stack of any combustion process.

Mrs. LLOYD. Turning to the solar detoxification, would you give us some more information on the status of this program and how the Department plans to proceed on this initiative?

Mr. DAVIS. Well, scientifically we know that if you concentrate sunlight on a target, there's certain things you can do with light. You can take the approach of either using very high concentrations of sunlight or lower concentrations in the presence of a catalyst. That gives you the opportunity to react some of the waste streams that are problems to us.

So in a laboratory we can do that. There's no question of the science. We can design a process that will destroy a particular kind of waste. We can do that with sunlight. Can we scale it to the point where it would be at all applicable to the tremendous volumes of, say, liquid waste that we generate is the next question. We think it's important to marry a technology. We're not in any way stepping away from solar thermal applications in terms of power. But given the attention that we're now paying to waste and waste treatment and waste streams, since the technology is applicable, the legitimate question is can we scale it up and be competitive with other treatment opportunities.

Mrs. LLOYD. Thank you.

Mr. Morrison.

Mr. MORRISON. First, Mike, I'm pleased with the reorganization. I think it reflects a lot of thinking, and I'm glad you reached down into your team because we've known some of the members of that team through the years. I know biomass, by any other name, is a winner. I certainly would agree.

One thing I am aware of is that your plans, particularly in the financial arena, go beyond our authorization levels. Madam Chairman, I think the Subcommittee should be aware that their restructuring has led to our authorization bill looking a little puny in a couple of categories, and I'm not sure how we address that, except perhaps to get Mr. Davis' recommendations on what we might do, so that our authorization levels are not holding him down in any way as he looks to future budgets.

Mrs. LLOYD. We certainly are aware of the shortfall and want to do what we can to cooperate with the Department of Energy, Mike.

Mr. DAVIS. Thank you.

Mr. MORRISON. A couple of localized questions for me. I wondered if you could describe your plans for the Pacific Northwest Energy Initiative and who are the players in that process.

Mr. DAVIS. What I tried to do initially was just introduce myself to a substantial resource at the Pacific Northwest Laboratory. I do know the people at Bonneville to an extent, and I know the people in the Northwest Power Planning Council, and you put that together with the State energy offices from Washington and Oregon and others and you've got quite a capable group of people. So, without knowing exactly what the result might be, I challenged them to sit down and work collectively together and bring forward some actions that they would all jointly support.

Now, I would say that there's still more work to do on the topic, but the door will not close. Those people have made long contributions to understanding energy use in buildings. It's true of other laboratories as well. And they will continue to work on that and sharpen it to the point where we can move it forward in our budget.

So, right now, it's still in the development stage, but I'm encouraged. And as I talk to PNL and as I talk to Bonneville, I think there's some more work they have to do jointly to be specific, but I'm confident that they'll do it.

Mr. MORRISON. I'm pleased that you have brought them together. That is sort of a unique laboratory opportunity, if you will. I'm pleased that we passed our second stage of energy conservation standards for buildings, but would note—and it may be of some interest—that a lot of the industrial standards that were approved some time ago have proven to be false because of the volume of energy used on what they call plugs, people plugging computers in at their individual desks, and no one planned on that.

I was wondering, does the Department have any initiatives underway that relate to waste minimization and energy efficiency that are included in your 1991 budget package?

Mr. DAVIS. Not specifically in 1991. As you look around our 1991 budget, you can see, I think, a number of programs that clearly could be grouped under the whole idea of the topic of either waste conversion or waste minimization. The steel initiative, in a way, is a waste minimization approach. Some of the higher temperature materials activities that we've got underway result in higher efficiencies and, in my mind, that's waste minimization, whether it's waste energy, whether it's waste materials, all aimed at getting more energy out for the same amount of output.

In our 1992 planning, we've made it a major point of focus across our industrial programs, the concept of waste conversion. There's always going to be waste, and no matter how perfect your process is, you produce a widget, that widget eventually exceeds its useful life, and then it becomes a target for recycling. So the concept of waste conversion, either to energy or to other higher value products, waste minimization, are going to be ways that we focus our 1992 budget.

Mr. MORRISON. I'm sure that's going to be an essential part of future deliberations in every—I would hate to have widgets, though, which are used so classically as examples, have any relationship with waste at all.

Thank you, Madam Chairman.

Mrs. LLOYD. Thank you.

Mr. Wolpe.

Mr. WOLPE. Thank you, Madam Chairman.

How many programs do we now have going with respect to the municipal waste to energy kind of initiatives? How much federally-sponsored or joint ventured research is in process?

Mr. DAVIS. Well, we probably have two or three million dollars in our current program looking at various topics associated with municipal waste conversion, whether that's anaerobic digestion or whether it's conversion of waste to liquids. But what we really don't have, at least in my mind, was a little bit broader view of the issue. We don't have joint ventures going on; we're not looking at the issue of what currently is happening and what currently stands in the way of municipal solid waste because our focus has been longer term. What I want to be sure of is, if we are doing longer term work, there's still an industry left when we get there with

some of this technology that's able to manage, in a positive way, municipal waste.

There's a lot happening on the topic. There are a lot of regulations that are being considered, maybe in advance of really knowing what the best avenues for treatment are.

Mr. WOLPE. So there are no demonstration projects at all right now?

Mr. DAVIS. There are none that I'm aware of—that we're funding. Let me put it that way. There certainly is an active industry out there busy pursuing various municipalities.

Mr. WOLPE. Is it a question of you not having the authority or not having the resources?

Mr. DAVIS. I think that it's—it's not a question of authority. I think it's a matter of us bringing forward a program that's got the right balance to it.

Mr. WOLPE. I mean, there's no ongoing grant program to which interested applicants could seek Federal support for an R&D effort in this area?

Mr. DAVIS. Well, certainly the—I mean, the possibility of an unsolicited proposal is always open for us to consider, and we have an energy-related inventions program and other ways that we could provide money to a request on that topic or many others. So there are some avenues. But I wouldn't say that we have a major program design for that aspect of energy technology.

Mr. WOLPE. How about the transportation fuels question? What do we have in process at the moment in terms of Federal support for that?

Mr. DAVIS. Well, the biggest piece of Federal support, of course, is tax advantage in terms of ethanol. That's a substantial market pull. Our activities, which you've been associated with, technology, we're really looking at thermal chemical production of methanol and biochemical production, if you will, of ethanol.

That used to be a joint effort between the Department of Energy and the Department of Agriculture. Over the years, the Department of Agriculture decided to drop that aspect of it, and now I think, quite positively, we've got the Department of Agriculture back involved from the very top—Secretary Yeutter is positive about this—where agriculture will lead the feedstock work, as I think it's appropriate they do, and energy will lead the conversion work, the conversion of that feedstock to, particularly in this case, ethanol.

Mr. WOLPE. Again, is this research that's being done within Federal laboratories, or is this a joint ventured activity with——

Mr. DAVIS. I don't think it's quite joint venture as envisioned by some of this legislation, but in my mind, it still is. Most of the feedstock work is managed out of Oak Ridge, and there's both laboratory efforts associated with it and private sector contractors that the laboratory develops a relationship with.

The conversion work is essentially the same. Most of that work is done at the Solar Energy Research Institute, and again, they contract for support on those efforts.

Mr. WOLPE. One of the things that I've been truly interested in in the last few years has been the effort of redirecting some of our focus at pollution prevention. I was therefore very surprised and

concerned by the Department's requesting a $10 million cut in the industrial processes research budget. The research that is being undertaken within that rubric impacts directly on the whole concept of pollution prevention. I'm wondering why the reduction in emphasis there.

Mr. DAVIS. The major reduction there was due to, if you will, a one-time funding spike in fiscal year 1990 for the steels initiative. The reduction of approximately $10 million, $8.5 million of that is reflected in our request for the steels initiative in 1991. We requested roughly $8.5 million there, and we think that's sufficient to continue that program based on the amount of money that's already been appropriated, and the various activities underway within the program. It does not represent a de-emphasis. It represents just the reality that we think we have enough money to pursue the program at the current level. That's the big difference between roughly $50 million of appropriations in 1990 and our $40-plus million request in fiscal year 1991.

Mr. WOLPE. Though the payoff is so much greater, that the notion that somehow there's nothing else one could identify as fruitful research, frankly, is rather surprising.

Mr. DAVIS. I certainly understand the point you're making. I don't always want to be saying "wait until next year", but we've taken those issues seriously, we think we've done our homework, we've put ourselves in a better position to make those benefits more obvious, and we'll compete more aggressively under the whole topic of waste conversion and waste minimization.

Mr. WOLPE. Thank you very much, Madam Chairman.

Mrs. LLOYD. We will recess for a recorded vote and will return.

[Whereupon, the Subcommittee was in recess.]

Mr. MORRISON (presiding). I would like to reconvene the hearing, please. Our Chairwoman is busy elsewhere for a few minutes and has asked me to go ahead.

We have questions continuing from Mr. Buechner for Mr. Davis.

Mr. BUECHNER. Thank you, Mr. Davis.

I would like to ask, Mr. Chairman, that I've got a number of questions here that I would like to have entered into the record for Mr. Davis and have him answer at his leisure. I know we have two other distinguished panels, and rather than take up the time, if he would do that. They basically deal, Mr. Davis, with the methodology for the reorganization, who took part in the task force, what types of interaction there was, and then some of the other initiatives. I would appreciate it if you would, at your leisure, answer those for the record.

Mr. DAVIS. Yes, sir.

Mr. BUECHNER. I do, however, want to bring back something you pointed out that at the time that you all were preparing the bill itself, that I think 1218 had not been enacted into law. With that in mind, there was a section in there that referred to hydrogen energy systems program. It is not included as a separate line item in this proposal, as required by law.

Will the Department be submitting an amended budget request listing this hydrogen program?

Mr. DAVIS. Yes, we will submit that as a line item in our '92 request.

Mr. BUECHNER. Okay, fine. That's—I just wanted to know. That is on behalf of Mr. Walker, who is the Ranking Member of the overall Committee, and who has, as you know, expressed a very dedicated interest on the whole issue of hydrogen. So thank you.

I would like to just close out on the trash to energy issue that Mr. Wolpe raised with you. In St. Louis, what was a much heralded trash to energy proposal some years back, they just recently announced that they were not going to continue with that next year. And the reason is that—they stated that they just didn't have the independent funds to separate batteries and other types of highly toxic producing materials.

Do you have any kind of ideas being brought forth that, other than true separation, which—I mean, people having the responsibility to separate them and doing it. Are there any demonstration projects in the works that provide incentives to find a way to get these out, whether it's taxing batteries or doing something like that, so that working propositions like the one that we had can continue without the danger of these materials?

Mr. DAVIS. There are certainly provisions certainly being discussed, in terms of tracking things like batteries, so that they don't show up in the waste stream. I think that has to be very carefully thought through as well. I don't know what the best approach is.

You point out there's certainly a problem, and it has to be addressed, as to how to sort these things and how to prevent certain wastes from getting into the combustion. If that can be done, can be done at an appropriate cost, that certainly helps the whole proposition. So whether it's done through some technology that could effectively sort things, or whether it's done through a regulatory approach that would somehow track certain problem wastes and prevent them from showing up in the waste stream, our approach would be to try to find the technological solution to that.

Mr. BUECHNER. I think the only one question that I would like to kind of separate out of the ones that we're going to submit to you—just hold on a second—was the question about the, in 1218, there was a requirement for a series of joint ventures. Are there any discussions that are taking place right now with industry to begin that process, and has the Advisory Committee been formed?

Mr. DAVIS. We have developed a charter for that Advisory Committee, and we've also had what I believe is fair to describe as indirect discussions. I have a personal concern that before we create expectations, before we commit the DOE to certain projects, that we really need to understand where the appropriations are going to fall out.

As I said earlier, we had our budget forwarded and closed before this consideration was really looked at. There are a number of technologies where, frankly, I think we are tightly funded. Our request is very tight in the 1991 program. To take joint ventures that are required out of that particular request would be difficult.

One specific example is WIN. So I think we're going to need, before we move forward—and we certainly want to do that, and we've laid the groundwork to do that—but it's quite important to us what actually happens in appropriations to address these joint ventures.

Mr. BUECHNER. Thank you.

I yield back, Mr. Chairman.

Mr. MORRISON. Thank you, Mr. Buechner.

We have just gotten notification of another vote, but, Mr. Davis, we appreciate your testimony and answering questions. I think we do have at least some written questions that will be coming to you. We thank you not only for being here today but for the good job that you're doing in this most vital energy area, so thank you very much.

Mr. DAVIS. We thank you as well.

Mr. MORRISON. Rather than start the next panel, we will run and vote right now and then start as soon as we get back. The Subcommittee will stand in recess.

[Whereupon, the Subcommittee was in recess.]

Mr. MORRISON. The hearing will proceed. Mrs. Lloyd will be returning in a few minutes, but she asked that we go ahead and introduce the next panel and have them proceed. The panel will come to the table, please. Mr. Scott Sklar, Executive Director, Solar Energy Industries Association; Dr. Eric Hirst, Corporate Fellow from Oak Ridge; and Professor Yogi Goswami, Vice President of Energy Resources, American Society of Mechanical Engineers.

Gentlemen, we appreciate your participation in the hearing. Scott, since you're the most experienced, if you would go first, please.

STATEMENT OF SCOTT SKLAR, EXECUTIVE DIRECTOR, SOLAR ENERGY INDUSTRIES ASSOCIATION

Mr. SKLAR. Thank you, Congressman. I appreciate to have the opportunity.

As you know, the Solar Energy Industries Association is a national trade association of the passive solar, photovoltaics, and solar thermal equipment manufacturers and component suppliers. We basically have three things to raise with the Committee in general regarding the budget request, the reorganization, and then the actions as you requested regarding P.L. 101-218.

I would be remiss without just giving a quick statement as to the status of the solar industry. Photovoltaic sales are up 37 percent over last year; the market is expanding. Solar thermal power, we're nearly upto 300 megawatts, with trough technology commercialized in the marketplace, and hopefully dish/engine technology very shortly. Passive solar equipment is on the rise in buildings, and I think ultimately the design tools that are coming out of the DOE program are going to expand this, as well as the new glass and energy-efficient lighting. And finally, solar water heating sales are up about 15 percent, over 1.5 million buildings with them, now.

The bottom line is, first, I want to thank this Subcommittee for passage of P.L. 101-218, the law which provided the reauthorization in joint ventures for the renewable energy budget. The industry supports what this Subcommittee's role was in the passage of that legislation, and it set a new attitude regarding renewable energy in the Administration, and you deserve a lot of credit for that positive activity. So thank you, Congressman, for your support in that regard.

Mr. MORRISON. Thank you for the kind comments.

Mr. SKLAR. Regarding budget, we generally support the Administration's budget. The international program, which they are recommending around $1.5 million for CORECT activities, is about the right level. The photovoltaics program, an $8 million increase to $43 million, is an intelligent approach. That program needs to rise around $50 million to be competitive with the Europeans or Japanese, but the trend is right.

A $4 million increase in solar thermal funding is an intelligent way in which this program ought to go. The Administration has put that effort, that increase, mostly in the solar detoxification effort, and that is a good way to commercialize in the short term solar energy components.

My strongest problem we have is with the solar buildings budget. Remember, 35 percent of U.S. energy goes towards buildings, and there they have cut, in the Energy and Water Appropriations, $3.2 million out of a $4.2 million program. That is not a good sign. They promise that that will be covered in the Interior Appropriations side under the community building systems line item. We are going to the Appropriations Committees to work out an approach so that this research will not be lost in the active and passive solar side. We must have some oversight by this Committee to make sure this research isn't lost, both this research and some of the conservation research that Dr. Hirst will talk about, I'm sure. It is all very, very essential, and with any reorganization and changes in budgets, it's important that things don't fall through the cracks.

The international program on CORECT has been a very, very effective program, and we again believe, because of the reorganization, there is some concerns we have in the industry that some of the priorities may be changing in a program that has really been established to promote markets with the U.S. industry overseas. We are concerned that this program may be broadened in ways that does not really involve market promotion. So we are again coming to the Committee. You included reauthorizing CORECT because this was a successful program. This program needs to be overseen in a way that the industry is supported to promote its activities.

Over 50 percent of our solar sales are overseas. The only reason this industry is alive in markets where energy prices have gone down is our overseas market. So we are again being very explicit that the money that is appropriated in the one million to $1.5 million range goes towards overseas outreach entities in the Pacific Rim, Caribbean Basin, and even potentially Eastern Europe, for information and market analysis for overseas, for continuing our efforts in the Pacific Rim where we have teams going to Indonesia and the Philippines, and then assistance with the different renewable energy trade associations to help different industries in different market sectors. This program needs some strong, strong oversight by the Committee to make sure that collaboration exists.

In regard to compliance with P.L. 101-218, which establishes joint ventures, I share Assistant Secretary Davis' concern that these joint ventures—DOE needs to feel its way and make sure that, within the appropriations request, that it doesn't unfairly scoop money out of core R&D programs. I share that concern.

On the other hand, we have questions on the Hill, as you know, Congressman Morrison. For years we have put money in these programs; what do we get out of them? One of the ways you get technology out of the laboratory is to ask the industry to put some money up and have the Government put some money up and pull some of these technologies out, so people can see them. We need to do that. It is important.

The photovoltaics initiative proposed by the Administration is one such initiative that really has that characterization, where it is using about 80 percent of the $8 million to help photovoltaic companies get over manufacturing hurdles, technical problems, to scale up and start mass producing the technology. Industry is going to be putting up money, the Government is going to be putting up money. That's a good idea, and so they're doing that.

In solar thermal technology, the detoxification initiative really doesn't fit under the spirit of the public law because there's no detoxification solar industry in existence yet. This is a pure research approach that has—will be able to commercialize components in the short term. And so this program has put millions and millions of dollars into dish/engine research so that we can start using concentrated sunlight on external combustion engines—we think it's a few years getting into the market—and we need to start promoting that technology where the Government has put in this kind of investment and get it out of the private sector already, because I'm tired of saying that in a few years down the line you may see it. This kind of joint venture will make that a reality.

I can see the same thing with desiccants for solar cooling, different heat pipe technologies, electrochromic windows, a whole range of energy conservation technologies which my industry is into. And so, again, while i think DOE needs to find its way in this and work it out, I don't think the Subcommittee ought to back off from the joint venture requirements and make sure that DOE does this, because it is an essential part of the research budget.

The next issue I would like to raise is the DOE reorganization. We support the reorganization based by end use. I think what Mr. Davis has done is an intelligent approach. It has done three things. One, it has revitalized the management staff of the agency, and we think, after eight years of lower budgets, it gets demoralizing, and being able to bring some of the shining stars into the management is a good idea.

The second thing it has done is it allows many of our technologies which have similar problems—either in the utility sector or transportation sector—get in to resolve the same problems together under a single program. We think that's a good idea. But I also express a caveat to this Committee, and a very clear one, and that is that a reorganization like this by end use is going to make it harder for you to track money and where it's going.

I'll give you some examples. We have two different solar thermal activities, one on dish/engines, central receiver troughs under utilities, one on solar detoxification, using the exact same technology. And photovoltaics could be in each of those five areas. Photovoltaic charging for electric vehicles, photovoltaics obviously in the utilities sector, photovoltaic applications in the buildings sector. And so it's going to be a little harder to track these programs.

If, indeed, there's a good cooperative spirit between the Committee, DOE and the industry, this reorganization is going to work with flying colors. But, indeed, if there's some breakdowns here, it's going to be hard to track where this money's going. I think there needs to be some timely review of that in a way that the Committee can keep track of where these programs go.

The third issue involves CORECT, is again, the CORECT program falls under the technology transfer national program area. I am very, very concerned, we do not want CORECT to turn into a technology transfer program. We want it to be an international market promotion program. I cannot emphasize that enough.

I have three comments on the other program items. First, the Solar Energy Research Institute. We support its request for planning and development for a new laboratory. It makes sense. It obviously should be above and beyond the core research program and not impinge upon the core R&D effort. So the building is a good idea. It's warranted and sound.

However, we have asked the Appropriations Committees very strongly, and we also ask the Subcommittee, that the building itself incorporate off-the-shelf, cost-effective applications of energy conservation, passive solar, potentially active solar, and photovoltaics. The U.S. Government—the way to commercialize technology is government by example. The premier solar laboratory ought to have confidence in the technology it uses, and it ought to be required. So, in that way, we think not only will they have a new laboratory, but it will also make a statement in the marketplace. This is not to be a demonstration. It's cost-effective applications.

The second issue is we do believe, quite strongly, in certain of the capabilities existing at some of the national laboratories outside of SERI. The Sandia Design Assistance Center, Lawrence Berkley Laboratories and windows, for instance, where our trade association has worked, we expect those programs to be maintained. I have some concerns in the reorganization that some of the brain trust we've developed in these programs and experience may be altered. We find that unacceptable.

My basic conclusion in the Committee is the Administration's proposals are essentially sound. It's about time that we are perceived as a strong component of the R&D program overall at DOE. The reorganization can work, and I think it's a valid approach, as long as it's watched. The international programs, as well as obviously the joint venture and R&D programs, must ensure that industry is collaborative with them. I do have some concerns that when programs get expanded, they sometimes get into empire building and we lose the focus of what they're there for. They are there to create technology and to commercialize it with U.S. industry.

Finally, we do support the expansion of SERI's activities and its building as well as the capabilities of our other solar programs at some of the other prime solar Federal research facilities.

Thank you for the opportunity to testify.

[The prepared statement of Mr. Sklar follows:]

SOLAR ENERGY INDUSTRIES ASSOCIATION Suite 610 1730 North Lynn Street Arlington, Virginia 22209-2009 (703) 524-6100
FAX (703) 527 2833

STATEMENT

by

SCOTT SKLAR
EXECUTIVE DIRECTOR
SOLAR ENERGY INDUSTRIES ASSOCIATION

before

SUBCOMMITTEE ON ENERGY RESEARCH & DEVELOPMENT
HOUSE SCIENCE, SPACE, & TECHNOLOGY COMMITTEE

JUNE 6, 1990
WASHINGTON, D.C.

INTRODUCTION

The Solar Energy Industries Association (SEIA), the national trade organization of the passive solar, photovoltaics, and solar thermal equipment manufacturers and component suppliers, will testify regarding our industries views on:

- o Administration's FY'91 Budget and Program Recommendations
- o US/DOE Conservation and Renewable Energy Reorganization in 1990
- o Necessary Actions to Comply With P.L. 101-218

However before these issues are addressed , the status of the U.S. solar energy industry should be outlined. The passive solar industry sales are increasing due to a greater acceptance of energy efficient lighting and glazings and new building design tools. Photovoltaics sales should exceed the previous year's sales by 40 percent primarily due to the increased Third World, consumer, and remote electricity markets. Two world record efficiency breakthroughs of 36 percent for concentrator photovoltaics and 24 percent for fiat plate photovoltaics were made in 1990. Solar thermal power is expanding in the utility sector with the newest 80 MW solar electric plant operating in 1990 (making a total of 274 MW produced) and the early 1990's will present a series of joint ventures to finally commercialize dish/engine applications. Solar water heating applications are also expanding slightly in the marketplace as will solar-powered desiccant coolers and solar-heated industrial energy systems if the U.S. Department of Energy maintains its focus and commitment.

The U.S. solar energy industry is growing due to advances in the technology, competitiveness in the maretplace, and responsiveness by the Congress in promoting supportive policies in building a United Sttaes solar energy industry. This Subcommittee deserves commendation for the passage of P.L. 101-218 in December 1989 establishing authorization levels and joint ventures for solar energy. Moves by other Congressional subcommittees to extend the ten-percent commercial solar tax credit and extend the PURPA limit beyond 30 MW also sent important messages to the financial and consumer markets.

This year, 1990, is critical to the growth of our industry. Due to still ever-increasing foreign competition supported by increasing national R&D budgets from the European Community and Japan, the United States must re-establish our lead as a result of our emergence in the technical and policy arenas. Therefore our industries' successes in 1990 will be reliant, in part, on how well we implement P.L. 101-218 and the new initiatives proposed by the Administration.

THE FY'91 PROGRAM & BUDGET

The basic trends in solar R&D funding are now upward due to strong Congressional and now, stronger Administration support. But increased funding must be tied to strong management, solid research programs, and pragmatic commercialization efforts. Funding for FY'91 as requested by the Administration, P.L. 101-218, and SEIA are as follows:

SOLAR PROGRAM	US/DOE FY'91	P.L. 101-218	SEIA FY'91
INTERNATIONAL (CORECT)			
FY'90 $1.04	$1.5	$3.0	$3.5
PHOTOVOLTAICS			
FY'90 $35.5	$43.0	$39.0	$48.0
SOLAR THERMAL			
FY'90 $15.0	$19.0	*	$28.5
SOLAR BUILDINGS			
FY'90 $4.2	$1.0	*	$11.8

* Not explicitly directed in P.L. 101-218

As you can see from the current solar R&D funding levels, all are moving upward from the FY'90 funding levels. However while the general trends are all upward, the specifics are not and our industry looks towards the U.S. Congress to guide these programs in a way that serves to rapidly commercialize solar technologies.

In the international program that supports industry efforts to build export markets, the program has been exceptionally effective because of the close working relationship of this program with the U.S. renewable energy industry. While the program has demonstrated great success, recent interaction with US/DOE staff has indicated a far broader view of the program and possibly a far less supportive and consultive interaction with the U.S. renewable energy industry. As a result, SEIA supports the $1.5 million FY'91 Administration request with $500,000 to establish overseas industry outreach centers in the Caribbean Basin and the Pacific Rim. An additional $250,000 to be directed to the current Pacific Rim market development and activities, $250,000 for information collection, market analysis, and information dissemination. And the remaining $500,000 be available to assist the renewable energy industries in specific market development activities and prefeasibility studies.

Photovoltaics research and development needs to be increased to $48 million. In part, the Administration's request of $43 million for FY'91 allows an increase of $8 million for a PV Manufacturing Initiative. About 80 percent of this $8 million will be directed to assist the existing PV manufacturers to overcome technical roadblocks to scale-up manufacturing. The remaining 20 percent will be directed towards shared research projects allowing the industry to collaborate on new PV modules and balance-of-systems and storage technologies. At least $35 million must be maintained as the core research budget for pure and applied R&D to be shared by the Solar Energy Research Institute (SERI) and Sandia National Laboratories.

In Solar Thermal Program, the Administration has requested $8 million for solar flux and solar detoxification research & development which would increase the current research effort by $4 million. SEIA believes that no more than $4 million be directed towards solar flux and detoxification and that the majority of these monies be used to finally commercialize dish/engine technology and advance existing trough technologies for both electricity production and industrial process heat. SEIA believes that both SERI and Sandia work in this field in both the basic research and applied research respectfully. This program must be allowed to enhance the competitiveness of existing trough technologies and insure the actual commercial development of solar dish concentrators tied to external combustion engines. The Congress must stick with our industry in the commercialization process of both trough and dish/engine technologies.

The Solar Buildings Program has potential to succumb unless the active solar heating & cooling, and passive solar design and materials development is added to the existing Community Building Systems program. SEIA has worked with US/DOE support and HUD to establish Solar Rating & Certification Corporation (SRCC) tests as acceptable under HUD/FHA/VA Minimum Property Standards, thus making them immediately accepted nationwide for incorporation of solar systems in national building loan programs.

Specials initiatives in the commercialization of energy efficiency lighting, solar desiccant coolers, and new glazing including electrochromic glass must be achieved. While lighting, heating and cooling buildings account for 35 percent of U.S. energy use, the solar potential may ignored due to decreased funding for solar buildings in the renewable energy sector, from $4.2 million in FY'90 to $1.2 million in FY'90, and no commensurate increase in the Conservation Program Community Building Systems Line-Item.

In fact new glass technologies such as using electrochromic glass (darkening-and-clearing glass via a small electric current), and layering glass with see-thru insulation, selective surface, and photovoltaics glazings and layerings. These glass innovations may save more energy than any other energy production technology in the American alternative energy arsenal. Because of basic disinterest and lack of direction, the Japanese, Swedish and German governments are banking that we will and give up a multibillion dollar market. The Congress must insure that these solar research and development options are preserved.

COMPLIANCE WITH P.L. 101-218

Aside from multiyear authorizations, P.L. 101-218 provides for the establishment of formal joint ventures to spur commercialization. The legislation provides $2.5 million respectively for industry/ government joint development ventures in photovoltaics and solar thermal technologies. In addition, $5 million and $1 million are provided for factory-made housing and district cooling technologies respectively.

In photovoltaics, the establishment of a manufacturig initiative supports the spirit of the law. Additional programs in utility scale-ups, storage and balance-of-systems work must be added. The solar thermal, the proposed solar detoxification initiative does not meet the criteria of the law in that there is no existing industry to cost share development at this time. A program must be implemented to develop a cost-shared dish/engine commercialization effort and new enhanced trough technology program in the short term, and a central receiver project in the longer term. The Subcommittee should formally request that these issues be addressed in the reporting requirement of P.L. 101-218.

In both the manufactured housing and district cooling technologies, any cost-shared project should require utilization of active and passive solar applications in any potential manufactured housing or cooling joimt venture. The US/DOE effort should establish prerequisite use of these technologies as part of a systemic integration of new technology. District cooling joint venture should be expanded to any new solar cooling applications such as solar heat pipes and desiccants.
The provisions to reauthorize the federal interagency board, CORECT, was a major benefit to a program that has been highly effective. The legislation expanded the mission of CORECT by including "energy efficiency to the extent it is a part of a renewable energy system or technology". Therefore, SEIA hopes that energy efficient lighting, for example, tied to photovoltaics and related efficient technologies could be supported under CORECT. In US/DOE's annual report to the U.S. Congress, the Subcommittee should review the extent the program actually promotes market development and how well the program relates to the goals of the industry.

The final section I wish to comment on is the requirement to establish educational efforts geared towards federal procurement officers. At present the Federal Energy Management Program (FEMP) has been delinquent in working with the renewable energy trade associations in developing educational programs for federal procurement officers. Per SEIA's repeated requests in 1990, FEMP declined to cost share an education program for military and local government procurement officers who are dealing with the devastation of Hurricane Hugo. SEIA believes the federal government can "prime the market" for solar technologies as they successfully did for transistor and computer technologies. Joint government/ industry programs must be initiated as required by the legislation.

THE DOE REORGANIZATION

The reorganization of the Office of [C]onservation and Renewable Energy has been carried out by Assistant [S]ecretary J. Michael Davis. The reorganization of and merging [o]f the management functions of the conservation and renewable [e]nergy programs by enduse appears to be an effective approach.

First, many of the conservation and renewab[le] energy technologies compliment each other. Secondly, many of the [c]ommercialization problems are also shared by technologies parti[c]ularly in similar enduse markets. Third, the government staffs ne[e]ded revitalization and broadening of purpose to build a new progra[m]. Fourth, this enduse approach -- buildings, industrial, nationa[l] programs, transportation, and uti[l]ities -- all[ow] m[ore] effec[tive] mar[ket] and planning.

The solar industry eagerly supp[o]rted Mr. Davis' nomi[n]ation because we believe he would revitalize the U.S. solar energy research & development program. I am pers[o]nally his booster in this regard, and I believe the reorganization will build the federal government's solar program.

However, I do expres[s] a caveat to the Subcommittee regarding the tracking of Congressional directives and funding. Because technology areas are dispersed sometimes into three or more separate management areas, it is going to be far more difficult to track funding and program implementation. For instance, solar thermal technologies are managed both in the Office of Waste Reduction Technologies (solar detoxification) and the Office of Solar Thermal & Biomass (solar thermal electric), and photovoltaics technology, in fact, could be dispersed in the building, industrial, utility and possibly transportation programs.

Clearly there is nothing wrong with such a dispersion within the solar research & development program as long as a cooperative approach to research & development exists between US/DOE, the Congress, and the industry. Other than concerns about planning and implementation of CORECT, I believe the environment lends itself to this approach. SEIA will advise the Subcommittee at a later date on the specifics of the programs and there implementation under this new reorganization.

Under the annual reporting requirements of P.L. 101-218, the Subcommittee should solicit industry association comments of the program management, implementation, and coordination with industry and its successes and problems. This kind of cosolicitation from industry would be a useful way to track the success of the reorganization and its effect on assisting the soalr industry commercialize technologies.

OTHER PROGRAM ITEMS

Solar Energy Research Institute (SERI): the U.S. solar industry supports the request for planning and development funding for a new SERI laboratory building as long as the funds are above-and-beyond the core renewable energy research & development program. No research effort should be impinged for this capital investment, but if funds are available such an effort is both warranted and sound.

Sandia National Laboratories (SNL): the Renewable Energy Design Assistance Center and applied solar research efforts must be maintained. Sandia has developed into a model applied solar research laboratory and deserves a strong base in the U.S. federal solar R&D program. While attempts to expand the SERI pure research program can be justified, it should not be done at the expense of the expertise of our primae applied R&D laboratory. A similar case can be made for maintainance of the window and advanced glazing program at Lawrence Berkley Laboratories (LBL), which is a world leader in advanced window technologies. A balanced laboratory effort is critical to an expanding solar program's success.

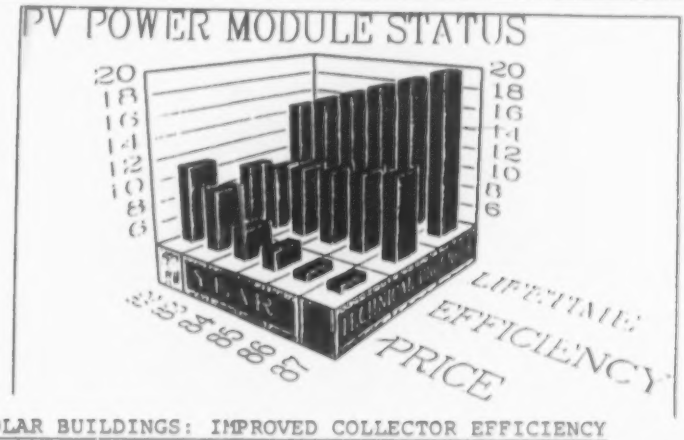
Energy Storage Program: While the program has focussed on battery storage for utilities, this program should be broadened to support advances in photovoltaic/battery modules, advanced balance of systems solar/battery electric production systems, and solar electric transportation systems. The program should not be stagnant just supporting a utility-based battery program but integrated into the existing solar research and development program.

CONCLUSION

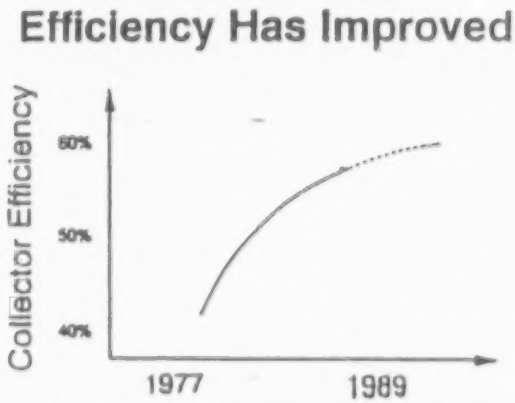
The funding proposals for the solar research program for FY'91 are ample except for the development of solar building technologies. The joint ventures mandated by P.L. 101-218 must be integrated into the funding request and attempts should be made by US/DOE to implement these joint ventures in consultation with industry. The reorganization of the conservation and solar energy program management is important but the Subcommittee needs to track the program more carefully. The SERI, LBL, and Sandia programs need to remain balanced and the new SERI laboratory should be added to the existing core and joint venture programs. The energy storage program needs to be better integrated into the existing solar research programs and CORECT planning should be made with strong consultation with the U.S. solar and renewable energy industries in order to be sucessfully implemented.

+++

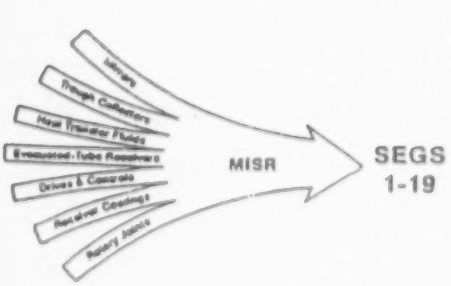
A. PHOTOVOLTAICS: EFFICIENCY, RELIABILITY & COST REDUCTIONS

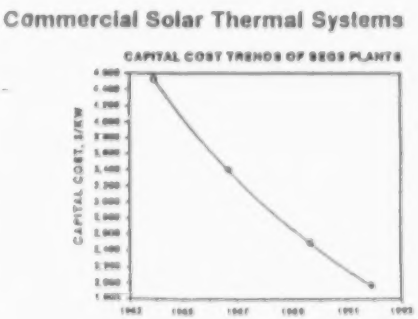


B. SOLAR BUILDINGS: IMPROVED COLLECTOR EFFICIENCY



C. SOLAR THERMAL POWER: LOWERING CAPITAL COST TRENDS





Mrs. LLOYD (presiding). Thank you very much.

Mr. Morrison, thank you for holding the operation down. I would like you to lead off, if you would, please.

Mr. MORRISON. Well, the next guy belongs to you.

Mrs. LLOYD. Pardon me. I thought they went one, two, three.

Dr. Hirst, we look forward to your testimony. I've been visiting with some of your colleagues from Oak Ridge while I was out of the room——

Mr. MORRISON. We weren't quite as efficient as you thought. [Laughter.]

Mrs. LLOYD [continuing]. Reviewing programs of mutual concern. I look forward to hearing from you right now.

Dr. HIRST. Thank you.

Mrs. LLOYD. We're very proud of you and what you're doing at Oak Ridge.

STATEMENT OF DR. ERIC HIRST, CORPORATE FELLOW, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TN

Dr. HIRST. You're timing was perfect.

Roger Carlsmith and I believe that the DOE budget for conservation and renewable R&D and programs needs to be increased. There is some economists who argue that the Government should not play a role in promoting energy efficiency because that would, in their words, "interfere with the normal workings of the marketplace." I would like to give one small example that shows why the Federal Government should support conservation R&D and programs to help consumers in all sectors of the economy improve efficiency of energy use.

This brochure was put out a couple of months ago from the Alliance to Save Energy in promoting energy-efficient lighting. The brochure gives the phone numbers of five different manufacturers and encourages readers to call these manufacturers to find out where in your community to buy these lights.

Well, I called all five companies, and only one of the companies could give me the name of a store in Oak Ridge in which I could purchase these lamps. When I called the store in Oak Ridge, they only sold one of these kinds of lamps. The other companies named stores that were at least 120 miles away. Now, I'm very much of an energy efficiency enthusiast, but I'm not going to drive to Nashville to buy energy efficient lights.

Although it's difficult—in fact, almost impossible—to buy these kinds of high-efficiency lights in Oak Ridge, the same is not true in other locations. For example, in Augusta, Maine, which is a town even smaller than Oak Ridge, these lamps are readily available. The reason is that the local utility in Augusta promoted these bulbs. Basically, Central Maine Power, the utility there, primed the pump by providing free light bulbs to any of its customers that wanted that. They did this for a couple of years and now the market is functioning. The point of this anecdote is that markets often don't work well and that Government and other major institutions can make a difference.

Roger Carlsmith, who coauthored the testimony with me, directed a study requested by DOE as part of their National Energy

Strategy. The study, which involved five national laboratories, looked at three scenarios of energy use out to the year 2010. One was a frozen efficiency scenario in which there were no improvements in energy efficiency. The second was called "Where We are Headed", and it was designed to identify what the future trends might be if we made no changes in Government policies or programs. And the last one was called "Cost-Effective Potential" and was intended to identify how much efficiency we could wring out of the system over the next 20 years.

The primary conclusion from that report, which was accepted by DOE, is that half of the potential to cost-effectively reduce energy use over the next 20 years will be lost unless we change Government programs and policies. And it's important to make those changes both for energy consumers and for the U.S. as a whole, for a variety of reasons. There obviously are the direct economic benefits to energy consumers. In addition, society benefits through improved economic productivity and international competitiveness, greater national security because we import less oil, and perhaps most important, improved environmental quality, fewer emissions that lead to acid rain and global warming.

Although we made great strides in improving energy efficiency between 1973 and 1986, the trends the last few years have not been encouraging. In fact, during that period, the percentage of our oil that we import has grown perhaps even alarmingly.

DOE's proposed budget for next year totals $213 million, compared with an fiscal year 1990 appropriation—that is, for this year—of $411 million. Thus, DOE proposes to cut funding by essentially one-half. This is puzzling, given what Mike Davis said earlier, the fine initiatives that DOE announced in January, and some of the very positive words about the importance of energy efficiency in the National Energy Strategy's interim report that was released in April. Rather than decrease funding for conservation R&D and programs, Roger Carlsmith and I recommend that funding be increased.

I would like to mention just two types of projects that we think merit increased funding, and note that our written testimony contains several more examples and, perhaps more important, this alternative budget for energy conservation that was released in April by the Energy Conservation Coalition and about 15 other groups has many more suggestions on R&D that is either unfunded or underfunded.

One important example that needs more research is foundations. Almost 95 percent of the homes in the U.S. have no foundation insulation. Analysis at Oak Ridge National Laboratory showed that adding insulation to existing homes could cut home heating bills by up to $5 billion a year. The University of Minnesota and Oak Ridge jointly developed a building foundation design handbook that recommends the amounts and types and placement of insulation for basements, crawl spaces, and slab on grade designs. These recommendations were adopted in ASHRAE standards but they were not adopted by the Building Official and Code Administrators National Energy Code that they adopted in January of this year. BOCA felt that more research was needed and that the recommendations in the handbook were not adequately justified. And they're right. The

handbook is based primarily on analysis with little empirical verification. And so experimental work needs to be done to determine the cost and the benefits of below-grade insulation, where it should be placed, how much, what type, and how that varies by climate zone and type of soil.

It would be important also to examine the effects of insulation on moisture in the building, radon, and termite activity. Essentially, the computer model results that are reflected in the foundation handbook need to be verified empirically.

Another example is home energy rating systems. We've done a lot of research over the last couple of decades on new technologies to improve efficiency of buildings, and some local governments, some utilities and state governments, have on their own developed different systems to rate the energy efficiency of homes. In a sense, these are analogous to the EPA fuel economy ratings for new cars that are widely used. Unfortunately, we now don't have such a system nationwide for rating homes. So when somebody goes to buy a home, either a new home or existing home, they have no way to assess what the likely fuel bills will be month after month.

DOE could review past experience with home energy rating systems from both technical and programmatic perspectives and use this information to develop and then encourage implementation of rating systems. These past efforts, combined with DOE's technical research on buildings—and Mike talked about the new office of Deputy Assistant Secretary for Buildings—could form the basis for a national rating system. Such a system could be implemented with DOE assistance and adopted by State and local governments, electric and gas utilities, and by realtors, appraisers and banks.

In my view, this represents a good example of the kinds of valuable technical assistance that DOE could provide, because it gives lots of leverage with very little Federal money, because the implementation is carried out by other organizations.

In conclusion, Roger Carlsmith and I suggest that the Subcommittee on Energy Research and Development increase the funding for DOE energy efficiency research and programs for fiscal year 1991. If we're serious about addressing environmental quality and economic productivity issues, we can do no less.

Thank you.

[The prepared opening statement of Dr. Hirst follows:]

THE FEDERAL GOVERNMENT SHOULD DO MORE TO IMPROVE U.S. ENERGY EFFICIENCY

Statement of
Eric Hirst and Roger Carlsmith
Oak Ridge National Laboratory*
Oak Ridge, Tennessee 37831

Before the
Subcommittee on Energy Research and Development
Committee on Science, Space, and Technology
U.S. House of Representatives
Washington, DC 20515

June 6, 1990

Madam Chair and Members of the Subcommittee, improving energy efficiency in the U.S. is probably the least expensive and most effective way to simultaneously address several national issues. Improving efficiency saves money for consumers, increases economic productivity and international competitiveness, enhances national security by lowering oil imports, reduces the adverse environmental effects of energy production (including acid rain and global warming), and responds to public interest in energy efficiency.

The Administration's proposed budget for Department of Energy (DOE) conservation activities in FY-1991 totals $213 million, a cut of almost 50% from the actual 1990 level. To address the problems cited above, Congress should restore some of the cuts in the conservation budget made in earlier years and increase funding for FY-1991.

OPPORTUNITIES TO IMPROVE ENERGY EFFICIENCY

A recent report (Carlsmith et al. 1990), commissioned for DOE's National Energy Strategy, examined alternative scenarios of future energy use in the U.S. One scenario, entitled *Where We are Headed*, examined the likely future trends in energy use in the residential, commercial, industrial, and transportation sectors from 1988 through 2010 (Fig. 1). This projection, reaching 102 Qbtu in 2010, reflects what might happen if current government policies and programs remain in effect.

Another scenario, called *Cost-Effective Efficiency*, examined what could be achieved if market barriers were overcome. These barriers prevent adoption of what would otherwise be economically attractive investments in energy-efficiency improvements. This projection

*Operated by Martin Marietta Energy Systems, Inc. under contract No. DE-AC05-840R21400 with the U.S. Department of Energy.

reaches only 88 QBtu in 2010 and reflects what might occur if government policies change substantially.

Comparing these two projections with a frozen-efficiency baseline (which reaches 115 QBtu in 2010) suggests that only half of the cost-effective potential for improving energy efficiency in the U.S. will be obtained. Thus, new government policies and programs could double the energy savings achieved during the next 20 years.

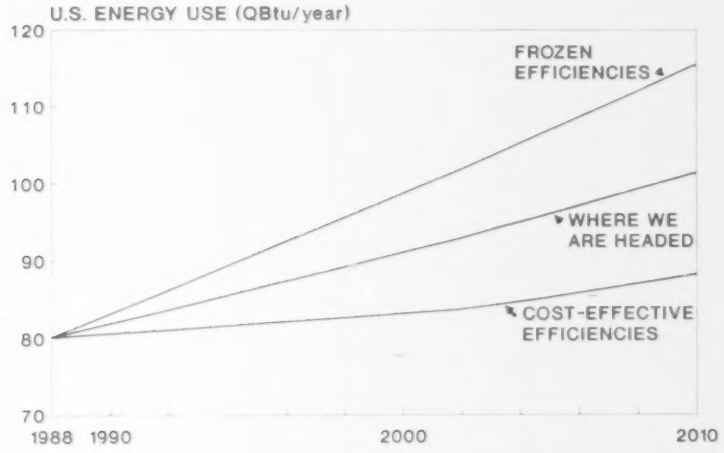


Fig. 1. Alternative projections of U.S. energy use from 1988 through 2010.

Many barriers stand in the way of achieving the full potential for cost-effective efficiency improvements (Hirst and Brown 1990). These barriers fall into two groups: structural and behavioral (Table 1). Structural barriers result from the actions of public- and private-sector organizations (including manufacturers, builders, wholesalers, fuel suppliers, financial institutions, and government agencies) and are primarily beyond the control of the individual energy user. Behavioral barriers, on the other hand, are problems that characterize the end user's decision making.

Recent trends in U.S. energy use show that the gap between potential and actual efficiency improvements may be widening. After more than a decade of steady improvements, the ratio of energy use to GNP (E/GNP) stopped declining in 1986 and has been essentially static since then (Energy Information Administration 1990). To be specific: E/GNP declined by 26% between 1973 and 1986; during the next three years, the ratio

declined only 2%. Also, U.S. dependence on oil imports has grown during the past few years, from 27% of total oil use in 1985 to 41% in 1989.

Table 1. Barriers to improving energy efficiency in the U.S.

Structural barriers
Distortions in fuel prices
Uncertainty about future fuel prices
Limited access to capital
Government fiscal and regulatory policies
Codes and standards
Supply infrastructure limitations
Behavioral barriers
Attitudes toward energy efficiency
Perceived risk of energy-efficiency investments
Information gaps
Misplaced incentives

NEED FOR A STRONGER FEDERAL ROLE

Six primary reasons justify increased government action to improve U.S. energy efficiency (Hirst 1989). First, energy efficiency is a proven resource. As the evidence from the 1973-1986 period indicates, efficiencies of homes, commercial buildings, industrial processes, and transportation systems have all improved dramatically. Also, large opportunities remain for further energy-efficiency gains.

Second, the retail prices of fuels and electricity do not reflect many problems associated with the production, transportation, and conversion of fuels. These problems include air and water pollution, long-term storage of nuclear wastes, oil spills, and dependence on foreign oil supplies.

Third, market imperfections keep consumers from making what would otherwise be economically rational choices, as discussed above. In addition to not reflecting the environmental costs just mentioned, fuel prices often do not reflect the marginal economic costs of providing the energy. For example, electricity prices are based on the average costs to provide the power. However, the costs to construct and operate new power plants are usually much higher than average costs. A similar situation occurs for natural-gas pricing.

Other market imperfections concern information. Consumers often find it difficult to obtain information on the energy-efficiency options they face. Even where information is available, it is often too complicated to analyze.

Many consumers are unable to affect the efficiency of the energy-using systems they operate. For example, tenants in a large office building have no influence on the efficiency of the lighting and space-conditioning systems. And builders, not homebuyers, usually select the appliances and space-heating systems in new homes. Not surprisingly, builders focus more on initial cost than on operating costs.

These market imperfections lead to decisions that weigh capital costs more heavily than reductions in long-term operating costs. These decisions are implicitly based on very high consumer discount rates. The difference between discount rates used in making energy-efficiency investments (20% to 100%) and those used in making energy-production investments (about 10%) is called the payback gap. Because of this payback gap, investments in energy *production* are much more likely to be made than are investments in energy *efficiency*.

However, government programs that overcome such market barriers implicitly reduce consumer discount rates, leading to the selection of higher-efficiency systems. As shown by analyses of automobiles and of residential space heating equipment (Hirst 1989), increasing energy efficiency does not increase total purchase and operating costs. Thus, government programs can provide large social benefits at no cost to individual consumers.

Fourth, energy-efficiency programs provide insurance. Even if concerns about global warming, acid rain, economic competitiveness, and the balance-of-payments are proven unfounded, it still makes sense to improve efficiency. Increasing efficiency produces economic benefits for the nation; reductions in fuel costs are available for investment in new plant and equipment and for consumer purchases. Energy efficiency also adds diversity and flexibility to the nation's energy system. Unlike most supply projects (e.g., development of a major oil field or construction of a large power plant), efficiency improvements are small and use a variety of technologies. Even if a particular initiative proves ineffective, the losses will be small and will be more than compensated for by the many other successful initiatives to save energy.

Fifth, federal fiscal policy has historically favored energy production over energy efficiency. In 1984, the Federal Government provided subsidies of more than $40 billion to energy-supply industries, primarily through tax breaks (Heede, Morgan, and Ridley, 1985). In comparison, only 6% of the Federal Government's energy R&D budget was allocated to energy efficiency in 1988 (Fulkerson et al. 1989).

Finally, public opinion supports greater efforts to improve energy efficiency. When asked to choose the single most important energy resource on which the government should spend more money, two-thirds of the respondents in a 1988 survey chose renewables or energy efficiency (The Analysis Group 1988).

DOE recognizes its responsibilities to improve efficiency. For example, DOE's (1990b) *Interim Report* from the National Energy Strategy says:

> The loudest single message [from the testimony prepared for DOE's public hearings] was to increase energy efficiency in every sector of energy use. Energy efficiency was seen as a way to reduce pollution, reduce dependence on imports, and reduce the cost of energy.

The report then devotes the first four (of 18) chapters to energy efficiency.

In addition, DOE announced, in January 1990, a series of new initiatives on energy efficiency and renewable energy (DOE 1990a). These initiatives were estimated to

> ... avoid damage to the environment by an estimated 800 million tons of carbon dioxide, 2.3 million tons of sulphur oxides and 2.1 million tons of nitrogen oxides annually.

These initiatives, when implemented, will strengthen the role of the federal government in promoting energy efficiency. For example, the proposal to relamp federal facilities will demonstrate the performance of new lighting technologies, encourage owners of commercial buildings to adopt similar measures, and save money for U.S. taxpayers. The companion initiative to help the private sector relamp commercial buildings could, according to DOE estimates, save $5 billion a year in electric bills.

Similarly, the initiative to expand DOE's Integrated Resource Planning Program will benefit electric and gas utilities and their customers. This DOE program works with utilities and regulators to improve resource planning, develop better data (especially on conservation and load-management technologies and programs), and create new computer models to analyze alternative resource strategies. Additional funding will allow DOE to conduct more cooperative projects to, as examples, analyze alternatives to traditional regulation to reward utilities for successful implementation of integrated resource plans, assess different ways to include environmental costs in utility planning, and treat uncertainty in planning and decision making.

Encouraging as these new initiatives are, the DOE commitment to improving U.S. energy efficiency can be measured best by its deeds and dollars. And here, the FY-1991 budget request does not show a strong commitment.

FY-1991 BUDGET FOR CONSERVATION

Funding for DOE conservation R&D for FY-1990 is $194 million. Funding for DOE state and local assistance is $217 million, bringing the total DOE conservation budget for FY-1990 to $411 million. DOE's request for FY-1991 calls for a 6% decline in funding for R&D and an 86% decline for state and local programs. Thus, the total funding request of

$213 million is barely half the present funding. As in previous years, conservation receives only a small fraction of the DOE budget. It is difficult to reconcile DOE's positive words about energy efficiency with a budget request that proposes to cut the programs in half.

The following sections briefly describe important R&D projects, funding for which would likely yield important ways to reduce energy use and increase productivity. Some of these projects deal with hardware (equipment and systems), while others deal with software (data and analysis). These examples are only indicative of the types of projects for which additional funding is needed. The *Alternative Budget for Energy Conservation, FY-1991*, prepared by the Energy Conservation Coalition (1990) and others, contains many more examples of important, but unfunded or underfunded, R&D projects and programs.

IDENTIFYING BARRIERS TO IMPROVED EFFICIENCY

DOE conducts almost no research to better understand the barriers discussed above. However, there is a real need to assess the importance of different barriers by economic sector (and perhaps by end use). It is also important to examine the effectiveness of different government policies to overcome these barriers, including more R&D, demonstration programs, government procurement of energy-efficient products, energy-efficiency standards, labeling and rating programs, and financial incentives to purchase more efficient systems.

Specific activities to be conducted include: reviewing existing data sources to quantify barriers for each sector, correlating data on barriers with information on the performance of different conservation programs and policies, and conducting experiments to measure the importance of specific barriers where existing data are insufficient.

ORGANIZING DATA ON ENERGY EFFICIENCY TECHNOLOGIES AND PROGRAMS

"Good public policy demands good information," according to the Office of Technology Assessment (1989). Unfortunately, the amount and quality of data on energy supply resources far exceeds that on energy conservation. For example, the Energy Information Administration (1989) *Annual Energy Review* contains separate chapters on fossil-fuel reserves, petroleum, natural gas, coal, electricity, nuclear energy, renewable energy, financial indicators, and only one chapter on energy consumption.

DOE could establish a center, perhaps at one of the national laboratories, to collect and organize data on (a) baseline energy use, by sector, region, and end use; (b) measured performance and costs of energy-efficient technologies and practices; and (c) measured performance of, participation in, and cost of different government and utility conservation programs. The center would work with EIA, DOE national laboratories, state energy offices, utilities, and other organizations to identify data sources and the key topics to address. Related work is already underway at the Lawrence Berkeley Laboratory. LBL has a small program to collect and analyze data on the costs and performance of energy-efficiency

measures for new and existing buildings. Similar work, underway at Oak Ridge National Laboratory (ORNL), examines trends in fuel economy of new cars and trucks.

THERMALLY ACTIVATED HEAT PUMPS

Absorption and regenerative cycle heat pumps could double the energy efficiency of current furnaces and boilers. The substitution of natural gas for electricity for summer cooling could substantially reduce utility peak loads and thereby defer the need for additional generating capacity. In addition to saving energy, advanced gas-fired heat pumps and chillers would have environmental benefits. The use of natural gas, which emits the lowest carbon dioxide levels of all fossil fuels, would reduce global warming.

Recently, breakthroughs in absorption technology were disclosed based on DOE research at the national laboratories. The triple-effect cycle developed at ORNL, licensed to the Trane Company and the Apache Corporation, and the ADR cycle are but two examples of a family of advanced cycles that hold great promise. Several additional concepts have been identified that will yield further improvements in energy efficiency. These include new absorption cycles that use new working fluids, additives, and materials.

The DOE proposal would reduce the funding for thermally activated heat pumps from $6.1 million in FY-1990 to $4.1 million in FY-1991. At this level, ongoing R&D would be curtailed, including work on prototype systems developed over the past several years. Engine-driven heat pump technologies are already at minimal funding levels, and further reductions may mean dropping these technology options altogether. Instead of reduced funding for this activity, we suggest an increase so that present programs can be completed and work started on the new concepts.

EFFICIENT ENERGY TECHNOLOGY FOR DEVELOPING AND EASTERN EUROPEAN COUNTRIES

The energy technology choices made by developing countries, including China, and by the countries of Eastern Europe, including the Soviet Union, will have a profound effect on world energy resources and the environment. It is plausible, for example, that CO_2 emissions from developing countries could exceed those from OECD nations within 20 years. Similarly, the growing demand of these countries for oil will put increasing stress on world petroleum markets. On the other hand, these countries represent large potential markets for U.S. energy technologies.

DOE can play an essential role in promoting the successful adoption of technologies that use and convert energy efficiently. Such adoption is one of the most cost-effective ways to reduce environmental impacts (e.g., emissions of greenhouse gases). The DOE effort would be an expansion of the CORECT (Committee on Renewable Energy Commerce and Technology) activities to encompass energy efficiency improvements.

Specifically, the initiative would include four activities: (1) R&D to adapt and develop energy-efficient end-use technologies suited to the particular conditions of developing countries and Eastern Europe; e.g., compact fluorescent lamps that can operate on systems subject to fluctuating voltages, and ground-coupled gas-fired heat pumps for cold climates; (2) technical assistance to key countries in collaboration with the U.S. AID and lending organizations; (3) establishment of a one-stop shopping service to provide technical information and to help establish meaningful contacts with U.S. suppliers; and (4) information gathering, assessment, and policy development.

This project will involve national laboratories, private manufacturers, U.S. utilities, the Electric Power Research Institute, the Gas Research Institute, and experts from the industrial and financial sectors. It will be coordinated with the AID Office of Energy, lending agencies, and energy conservation programs of other industrialized nations. The program could begin in FY-1991 at a level of $3 million, and gradually expand in future years.

CONTINUOUS-FIBER CERAMIC COMPOSITES

The use of ceramics for industrial applications is inhibited by its characteristic brittleness or low toughness. With recent advances in fiber technologies, it is possible to design a composite material based on continuous fibers embedded in a ceramic matrix. Like the cables or bars in concrete, these continuous fibers reinforce the ceramic and create a composite which is several times tougher (less brittle) and much less sensitive to strength-limiting flaws than the ceramic matrix. As a result of the enhanced properties, continuous-fiber ceramic composites (CFCCs) are attractive for use in a variety of industrial applications. One of the more important is in advanced burners and combustors. The use of CFCC materials in these installations would improve air quality by reducing NO_x emissions. Other environmentally related applications provide a major opportunity for CFCCs reduce pollution and improve industrial competitiveness.

The Department of the Interior and Related Agencies Appropriations Act of 1990 (P.L. 101-121) directed DOE to "complete a comprehensive continuous fiber composite research and development plan" which, "with financing options, should be forwarded to Congress no later than May 1, 1990." ORNL helped DOE develop the plan, based on inputs from over 120 companies, universities, and government laboratories.

The CFCC development plan calls for a significant development program addressing the specific needs of industrial applications. The proposed strategy for development is a joint research program among industry, universities, and national laboratories. The primary responsibility for process development will rest with industry to take advantage of their expertise in advanced materials processing. The more basic or generic supporting technologies such as micro- and macro-mechanics, materials characterization, and test method development will be accomplished in universities and national laboratories.

32-540 - 90 - 3

It is recommended that $6.5 million be added to the appropriation for Waste Energy Reduction to develop the primary processing methods for the reliable and cost-effective fabrication of CFCC components for industrial applications. The DOE request includes no funds for CFCCs.

EFFICIENT WINDOWS

DOE programs, conducted jointly by LBL and industry, have already resulted in broad introduction of low-E windows with an insulation level of R-3 to R-4. Current efforts to develop a "super window" with greatly enhanced performance (R-6 to R-10) are hampered by limited funding in FY-1990 and further reductions proposed for FY-1991. Such windows would be comparable to insulated walls in preventing heat loss in cold climates.

A companion project, the Fenestration Rating System, will help make windows more efficient in the immediate future. The objective is to provide a nationwide voluntary standard through which builders and homeowners can determine whether the most cost-effective windows are being installed. DOE should continue working with industry to bring the standard to the point of adoption.

Both of these programs require increases in funding to achieve their goals.

EXISTING BUILDINGS ENERGY EFFICIENCY RESEARCH

Residential and commercial buildings last a long time; almost 90% of today's buildings will still be in use in the year 2010. Thus, improving energy efficiency in existing buildings offers the largest potential for saving energy in the U.S. during the next 10 to 15 years. Widespread use of cost-effective retrofits for residential and commercial buildings could save 5 QBtu per year and reduce annual fuel costs by $30 billion.

The DOE Existing Buildings Program began in FY-1985 to assist the private sector in improving energy efficiency of buildings. One goal was to reduce the risk of retrofit investments by providing reliable data on actual energy savings and by developing more effective methods to select the best combination of measures. The dramatic improvements demonstrated from use of an advanced single-family audit is an example of benefits that can be achieved with research focused on existing buildings.

The new energy audit features the addition of retrofit measures for heating and cooling equipment, estimates of savings from combinations of envelope and equipment measures, and optimization of measures based on benefit/cost ratios. The audit was field tested in Wisconsin and in New York in cost-shared, collaborative projects with state and local agencies and utilities. Impressive improvements in energy savings and in cost effectiveness were demonstrated: the benefit-to-cost ratio (annual fuel savings per dollar invested) increased by a factor of three in both locations.

New research could dramatically increase the cost effectiveness of even those energy efficiency retrofits that have been commonly applied since the late 1970s. However, there has not been adequate funding to demonstrate the large potential savings in small-to-medium-sized commercial buildings or multifamily buildings. Over the next 10 years, new materials and adaptations of new technology must be developed that can cut energy use in existing buildings by up to one-half. Results of this retrofit research can also be used to develop and test Home Energy Rating Systems. Such rating systems can better inform homebuyers about the operating costs of existing homes. These rating systems can also form the basis for energy-efficient mortgages, which recognize the greater affordability of energy-efficient homes. Finally, retrofit research will benefit the Federal Energy Management Program and low-income housing, managed by the Department of Housing and Urban Development.

CONCLUSIONS

Improving efficiency of energy use in the U.S. yields important benefits. These include the direct savings associated with reduced fuel bills and the social benefits of reduced emissions of greenhouse gases and other pollutants, reduced dependence on foreign oil, and improved economic productivity and international competitiveness.

Unfortunately, these benefits will be realized only if the Federal Government actively promotes energy efficiency through increased research, expanded state and local programs, improved regulation of energy utilities, and increased technology transfer. Half the possible cost-effective energy savings between now and the year 2010 will not be realized unless government policies and programs are changed. A recent assessment (Fulkerson et al. 1989) suggested an increase of $300 million a year for conservation research, more than doubling the current budget over the next few years. The *Alternative Budget*, mentioned above, identifies R&D projects with a total funding level of $284 million for FY-1991, about $100 million more than the DOE request.

We conclude that the arguments for an expanded DOE program on energy efficiency are compelling and therefore suggest that the Subcommittee on Energy Research and Development increase such funding for FY-1991.

We appreciate the opportunity to testify before the Subcommittee and are glad to answer your questions.

11

REFERENCES

R. S. Carlsmith et al. 1990, *Energy Efficiency: How Far Can We Go*, ORNL/TM-11441, Oak Ridge National Laboratory, Oak Ridge, TN, January.

Energy Conservation Coalition 1990, *Alternative Budget for Energy Conservation, FY-1991*, Washington, DC, April.

Energy Information Administration 1990, *Monthly Energy Review January 1990*, DOE/EIA-0035(90/01), U.S. Department of Energy, Washington, DC, April.

Energy Information Administration 1989, *Annual Energy Review 1988*, DOE/EIA-0384(88), U.S. Department of Energy, Washington, DC, May.

W. Fulkerson et al. 1989, *Energy Technology R&D: What Could Make a Difference, Part 1, Synthesis Report*, ORNL-6541/V1, Oak Ridge National Laboratory, Oak Ridge, TN, May.

H. R. Heede, R. E. Morgan, and S. Ridley 1985, *The Hidden Costs of Energy*, Center for Renewable Resources, Washington, DC.

E. Hirst 1989, *Federal Roles to Realize National Energy-Efficiency Opportunities for the 1990s*, ORNL/CON-290, Oak Ridge National Laboratory, Oak Ridge, TN, October.

E. Hirst and M. Brown 1990, "Closing the Efficiency Gap: Barriers to the Efficient Use of Energy," *Resources, Conservation and Recycling 3*, forthcoming.

Office of Technology Assessment 1989, *Statistical Needs for a Changing U.S. Economy*, OTA-BP-E-58, U.S. Congress, Washington, DC, September.

The Analysis Group 1988, *Waste Not, Want Not: A National Opinion Survey on Energy Policy*, New Haven, CT, October.

U.S. Department of Energy 1990a, "DOE Launches Energy Efficiency and Renewable Energy Initiatives," News Release, Washington, DC, January 26.

U.S. Department of Energy 1990b, *Interim Report, National Energy Strategy*, Washington, DC, April.

Mrs. LLOYD. Thank you very much.

Again, we apologize for another vote. We'll be back shortly.

[Whereupon, the Subcommittee was in recess.]

Mrs. LLOYD. We will resume our hearing. I do apologize for all the break-ups in our hearings today.

Professor Goswami, you mention in your testimony that—you haven't given yours? You see, I came in when Scott was testifying, and I thought he was at the end—that that was one, two, three.

Mr. SKLAR. No. They put me up front there, Madam Chairman.

Mrs. LLOYD. All right.

I just reviewed your testimony, so we would like to hear your testimony.

STATEMENT OF DR. D. YOGI GOSWAMI, VICE PRESIDENT, ENERGY RESOURCES, AMERICAN SOCIETY OF MECHANICAL ENGINEERS, WASHINGTON, DC

Dr. GOSWAMI. Thank you very much, Madam Chairman. It is indeed a pleasure for me to appear before you on behalf of the ASME—that is, the American Society of Mechanical Engineers.

Let me give you some background before I go into the statement. Energy utilization and development of energy resources is an important part of the mechanical engineering profession, and the organization of mechanical engineers—that is, the American Society of Mechanical Engineers—has given a lot of energy into developing not only fossil fuels, nuclear energy, but renewable energy resources also. So, in other words, our society has been involved in all of these resources, and so I feel that we are in a unique position to give you unbiased, objective views of the renewable energy resources.

To prepare this review, we set up a task force of 16 nationally recognized experts in various areas of conservation and renewable energy, and a list of the task force members is attached with the written testimony. These members reviewed the budget carefully, and they consulted with other people also who were not on the task force, and, in addition, we discussed this subject at the 1990 ASME solar energy conference, and we got input from there also. So what I am about to say is a summary of this whole process.

We applaud the general trend of an increased funding request for renewable energy technologies, including solar energy. However, we have identified some concerns that we would like to share with you. We have seven general comments that apply to the overall budget request and then specific comments on the specific energy technologies.

The first comment—of course, you have heard a lot about, funding should be increased, and I am still going to make that comment, but no one can argue with the fact that the potential exists for the renewable energy technologies to increase their fraction of the country's energy supply from 9 percent now to about 20 percent. We feel that the pace of this increase needs to be accelerated, particularly in the light of increased concern for safety and environmental aspects of other energy supplies.

The budget that we have, even though it is a step in the right direction—that is, increasing—looking at the budget in 1981, it

pales in comparison with that budget, and, looking at the potential that renewable energies and conservation have, I think it is not proportional to that potential, and we feel that the Congress must try to increase this budget.

The second point is that a problem has persisted with DOE conservation and renewable energy programs, and that of lack of continued effort to bring technologies to a useful state of development for commercialization. Some examples of that are solar central receiver power systems, OTEC, Magma Geothermal Energy Program, and these are just a few of the examples. This represents, in our view, ineffective expenditure of taxpayers' investment in these technologies.

The third point is that the lack of funding continually hampers meaningful progress in development of new technologies. Researchers at the national labs and at the universities cannot maintain the required level of effort under these uncertain conditions. Public Law 101-218, the Renewable Energy Efficiency Technology Competitiveness Act of 1989, seeks to alleviate the situation by providing for a three-year authorization for these programs, and we applaud this subcommittee in achieving the passage of this important legislation.

We would also recommend that the Congress insist on DOE adopting a three- to five-year planning strategy for research and development funding. We also recognize that the DOE cannot realistically implement such a plan unless Congress backs up this Public Law 101-218 with the required appropriations.

The fourth point is that our task force views with cautious optimism the Secretary's effort in developing the National Energy Strategy. We would suggest that, in addition to utilizing input from the national laboratories in formulating program plans for renewable energy, that the Department and Congress solicit input from outside technical expertise throughout the Nation in the planning process. We would also suggest that an engineering society, such as the ASME, is especially well positioned to offer unbiased assistance to the Government decision-makers in setting up a blue ribbon panel of such experts and providing the forum or format for dialogue on key issues.

Another point that our panel or task force brought out was that the universities can play an important research role in the development of renewable energy resources because they have unique resources, including the faculty, the graduate students, and the research facilities which are already paid for by the State and the Federal Governments. I think that point is very important, that you have all of those facilities, but over the past few years the DOE has reduced utilization of universities for research and development, and that is a waste of an important national resource.

Now we recommend that in this regard a fixed minimum percentage of the conservation and renewable energy budget—and we suggest 15 percent for that—be used to support research at the universities and, furthermore, two-thirds of this research money should be made available for thesis and dissertation research without the usual programmatic constraints, and the reason for that is that this is where you will get the most innovative ideas that you may otherwise miss.

The sixth point is—this was brought out by the industry participants on the task force—that a regulation limiting the renewable energy electric power systems to 80 megawatts is hampering the efforts of renewable energy industry to reduce the cost of power. We recommend that this regulation be eliminated; in addition, a fresh look be taken at the standards and regulations that may be needed for orderly commercialization of renewable energy technologies.

The seventh and the last general point is in regard to technology transfer, that the task force strongly supports the DOE efforts to improve and enhance the technology transfer activities at the national laboratories primarily at the insistence of Congress and, in particular, this subcommittee. We find, however, that in many instances potential users of the technology go to the State agencies and the universities. In other words, they may not necessarily go to the national labs, that they seek this technology transfer from a source that is more local to them.

We, therefore, urge that Congress seek to strengthen the coordination among the States, universities, and the national laboratories in order to improve the technology transfer process. In our view, the local universities within a State are much more accessible to the users and effective in technology transfer than the Federal facilities.

We do have some specific recommendations about specific technologies. If there is time, I will go into that. Otherwise, they are in the written testimony.

Mrs. LLOYD. Very good. Without objection, your entire written statement will be made a part of the record.

Dr. GOSWAMI. Okay. Let me then go ahead and conclude.

Mrs. LLOYD. All right. Please.

Dr. GOSWAMI. In summary, our task force recommends that the DOE strategy for developing conservation and renewable energy resources must include a long-term, stable funding commitment to the Federal programs. Programs' priorities must be established for appropriate allocation of these funds using an independent, blue ribbon panel of technical experts to assist the Department in setting these priorities. In our view, the university resources and capabilities are presently under-utilized not only in research activities, but in the renewable energy options, but in the technology transfer area also.

Thank you.

[The prepared statement of Dr. Goswami follows:]

The American Society of Mechanical Engineers

Suite 218
1825 K Street, N.W.
Washington, DC 20006-1202
202-785-3756

Statement of the

Task Force on the Department of Energy

FY 1991 Budget Request for Conservation and Renewable Energy

of the

Council on Engineering

of the

American Society of Mechanical Engineers

Before the

Subcommittee on Energy Research and Development,

Committee on Science, Space and Technology

U.S. House of Representatives

June 6, 1990

Madame Chairwoman and Members of the Subcommittee:

I am pleased to have the opportunity to appear before you today on behalf of ASME's Task Force on the DOE FY 1991 budget request for conservation and renewable energy programs. I am Yogi Goswami, Professor of Mechanical Engineering at the University of Florida, and Vice President of the Energy Resources Group of the American Society of Mechanical Engineers.

The development and utilization of energy resources is a very important part of the mechanical engineering profession. Mechanical engineers and their technical societies, such as ASME, have made important contributions in all areas of energy technology including fossil fuels, nuclear energy and renewable energy sources such as solar, wind and biomass. For this reason, we are in a unique position to provide objective input into the national energy policy. Today, we are presenting a careful review of the DOE FY 1991 Congressional Budget request for Conservation and Renewable Energy.

To prepare this review, a task force of sixteen nationally recognized experts in various areas of renewable energy and energy conservation was formed. These experts are technical leaders from both academia and industry. A list of the task force members is attached to this statement. Each member of the task force has looked very carefully at one or more areas of the budget request and in many cases they have consulted with other experts not on the task force. In addition to these individual reviews, the conservation and renewable energy budgets were discussed in a plenary session at the 1990 ASME International Solar Energy Conference. The following is a summary of the comments generated through the above process.

We applaud the general trend for an increased funding request for renewable energy technologies including solar energy. However, our review has identified a number of concerns that we would like to share with you. We have seven comments that apply to the overall budget request for conservation and renewable energy and to DOE operations in general. In addition, we have comments related to specific energy technologies.

1. The potential exists to increase the fraction of the country's energy supply derived from renewable sources from 9% to 20%. The pace of this increase needs to be accelerated particularly in light of increased concern over safety and environmental aspects of other energy supplies. Irrespective of the level of urgency with which potential global warming is viewed, energy conservation and increased use of renewable energy need to be emphasized on their own merits including benign environmental effects and reduced dependency on imported oil. At the same time, increased use of these technologies, in all likelihood, will help reduce the prospect of global warming in the future. Despite these favorable characteristics, conservation and renewable energy programs are allotted about $300 million or about 1.7 percent of the total FY 1991 DOE budget request. This figure pales in comparison to the FY 1981 allocation of $1.04 billion or 11.3 percent of the FY 1981 DOE budget, when the U.S. commitment to preserving our indigenous energy resources through enhanced conservation and development of renewable energy resources was at its zenith. Clearly, the level of funding proposed for FY 1991, although a step in the right direction, must be viewed as far from adequate to develop conservation and renewable energy resources to their full potential.

2. A problem that has persisted with DOE's conservation and renewable energy programs has been the lack of continued effort to bring technologies to a useful state of development for commercialization. Solar Central Receiver Power Systems, OTEC and Magma Geothermal Energy are just a few of many examples. This represents an ineffective expenditure of taxpayers investment in these technologies.

3. Lack of funding continually hampers meaningful progress in the development of new technologies. Researchers at the national laboratories and at universities cannot maintain the required level of effort under these uncertain conditions. Public Law 101-218, the Renewable Energy Efficiency Technology Competitiveness Act of 1989, seeks to alleviate this situation by providing for a 3-year authorization for these programs. We applaud this subcommittee in achieving passage of this important legislation, and we would also recommend that Congress insist on DOE adopting a three to five year planning strategy for research and development funding. We also recognize that the DOE cannot realistically implement such a plan unless Congress backs up P.L. 101-218 with the required appropriations.

4. The task force views, with cautious optimism, the Secretary's efforts to develop a National Energy Strategy as a positive step in establishing national priorities in federal energy R&D programs. We would suggest that, in addition to utilizing input from the national laboratories in formulating program plans for renewable energy, the Department and the Congress should solicit input from outside technical expertise throughout the nation in the planning process. We would also suggest that an engineering society, such as the ASME, is especially well positioned to offer unbiased assistance to the government decision makers by setting up a blue ribbon panel of such experts and providing the forum or format for dialogue on key issues.

5. Universities can play an important research role in the development of renewable energy sources through effective use of their unique resources including faculty, graduate students and research facilities already paid for by the federal and state governments. Over the past few years DOE has reduced the utilization of universities for research and development in renewable energy and has thus deprived the nation of an important national resource for cost effective and innovative research. We recommend that a fixed minimum percentage (15% suggested) of the Conservation and Renewable Energy Budgets be used to support research at universities. Furthermore, two thirds of this research money should be made available for thesis and dissertation research without the usual progmmatic constraints.

6. A regulation limiting renewable energy electric power systems to 80 MW is hampering the efforts of the renewable energy industry to reduce the cost of power. We recommend that this regulation be eliminated. In addition, a fresh lock should be taken at the standards and regulations that may be needed for orderly commercialization of renewable energy technologies.

7. The task force strongly supports the DOE efforts to improve and enhance their technology transfer activities at the national laboratories, primarily at the insistence of Congress, and in particular, this Committee. We find, however, that in many instances potential users of technology produced at the national laboratories seek the assistance of state organizations and universities because they find the labs inaccessible or too costly for direct involvement. In such cases, the states and the universities serve as the conduit for getting federally funded technology from the national laboratories to the ultimate private sector users. We therefore urge that Congress seek to strengthen the coordination among the states, universities and the national laboratories in order to improve the technology transfer process. In our view, the local universities within a state are often much more accessible and effective in technology transfer than the federal facilities.

At this point, a more detailed discussion of specific energy areas is in order.

SOLAR ENERGY

Solar Thermal Energy Technology

Funding for solar concentrator and solar thermal power systems research should be continued. Every effort should be made to construct, with industrial cost sharing, a larger follow up to the "Solar One" central receiver power plant using modern technology. The regulatory size limit of 80 MW on renewable energy power plants should be eliminated. This will help the Solar Thermal Power industry reduce the cost of power, using economy of scale.

We suggest that the budget emphasis on research in high flux photon detoxification should be reviewed by an outside blue ribbon panel of experts consisting of engineers in the field of solar energy and waste management. Because of tight limits placed on the solar energy R&D budget, it is imperative that resource allocations be directed to priority programs. A review panel of the type suggested could serve to assist the DOE in program planning as well as assist in assessing the economics and commercial viability of solar detoxification.

Solar ponds represent an approach to solar energy utilization that holds great potential; however, research in this area was discontinued seven years ago. We recommend that this technology be pursued further.

Photovoltaics

We applaud the proposed increase in the budget request for photovoltaics. However, for the U.S. to maintain international competitiveness in photovoltaics, research funding must increase to a level comparable to the rest of the world (Japan: 1990 $50 M; Europe: 1990 $90M). New centers of excellence for photovoltaic development should be established at U.S. universities to help assure adequate progress. We recommend increased

emphasis and support for the following areas: 1) fundamental materials research; 2) advanced thin film materials; 3) improvement in current manufacturing techniques; 4) expanded utility applications of PV; and 5) incentives for commercialization of current technologies.

Buildings, Heating and Cooling

Solar heating and cooling remains one of the most promising applications of solar energy in terms of potential for reduction of fossil fuel consumption. Many of the problem areas addressed in the FY 91 budget request are short range in nature and designed to support existing solar industries. Areas such as reliability, maintainability, generic hot water systems, design guidelines, and test procedures are worth attention and should be pursued as proposed. However, an additional program of more imaginative long range studies on materials, processes and systems aimed at industries of the future should be developed.

Energy Conservation in Buildings

Energy consumption reductions in commercial buildings have been impressive during the past decade. However, indoor air quality has become a significant problem. Indoor air quality, ventilation and infiltration, all related to air transport, need intensive research, not only from the energy standpoint but also from the standpoint of the health and productivity of the occupants. A number of items in the proposed budget are particularly important and should be supported at increased levels. These include: 1) basement and crawl space energy losses and gains; 2) windows; 3) transport of daylight into the interior of commercial buildings; 4) thermal energy storage in structural mass to reduce peak electrical demands; 5) intelligent testing of buildings for diagnostic purposes coupled with intelligent control strategies.

Industrial Energy Conservation

The proposed budget cut of $10 million seems excessive, particularly when the potential for energy savings is still enormous. Cogeneration, advanced cycles, improved materials, and improved emissions for air quality are still very important areas and, to industry in particular, they are crucial issues.

The Energy Analysis and Diagnostic Centers are excellent programs because they help industry directly by reducing energy costs through energy audit recommendations. The plan to expand to 40 centers is good, but the pace should be accelerated and the funding for each center should be increased to at least $150,000 per year.

Energy Storage

Energy storage is important in optimizing the utilization of renewable as well as non-renewable energy sources. Storage is a necessary part of most renewable energy systems due to the fluctuating nature of the resource and it can play an important role for traditional power generation systems by minimizing the need for additional power plants to meet peak demand. We recommend research funding for battery and fuel cell research including solid electrolyte as well as proton membrane exchange fuel cells.

An ASME expert Panel reviewed the DOE Thermal and Chemical Energy Storage programs in 1989 and concluded that the programs are well run and are highly deserving of continued support. The panel strongly recommended that the budget be increased to a level of $5M so that the full impact of this important energy technology can be realized. The proposed FY 1991 budget, instead, shows a drastic decrease, in direct conflict with the ASME recommendation.

WIND

Commercial applications of wind turbines have shown tremendous potential. The proposed decrease in funding for this option is difficult to understand given the enormous short term and long term potential. Increased support for addressing the fundamental engineering issues underlying the structural failure problems that are hampering the industry and for new generation turbines and designs is required to advance the technology to allow the U.S. to compete with foreign countries for a share in this important international market.

GEOTHERMAL

The geothermal energy program has been plagued with the problem of too little funding, making continuity of research and development efforts difficult. In addition, politics, rather than technical merit, seem to dictate program priorities. DOE needs a better mechanism for soliciting and receiving constructive feedback from the industries involved in geothermal development. We again suggest a review panel approach.

The continued support for hot dry rock research represents one of DOE's few long term alternative energy development efforts. The zeroing out of the magma program, another long term program with good future potential, would seem to be in contradiction to the philosophy of supporting promising alternative geothermal resource development with long term benefits.

HYDROPOWER

The Task Force finds that the funds requested in the FY 1991 budget are adequate to identify problem areas surrounding licensing and regulatory policies and practices for existing and new hydropower projects. However, no definite deliverables are indicated in the budget item description. This approach will leave the hydropower regulatory review process open to continued problems and internal debate. This budget item should include funds in future years for the development of a document which streamlines the hydropower review and licensing process.

CONCLUDING REMARKS

In summary, the Task Force recommends that the DOE strategy for developing conservation and renewable energy resources must include a long term, stable funding commitment to the federal programs. Program priorities must be established for appropriate allocation of these funds using an independent blue ribbon panel of technical experts to assist the Department in setting these priorities. It is also our view that university resources and

capabilities are presently under-utilized, not only in research activities in renewable energy options, but in the area of technology transfer of viable technology developments to the state and private sector implementors of the technology.

This statement was prepared by the Energy Resources Group's Task Force on the DOE budget for Conservation and Renewable Energy of the Council of Engineering of the American Society of Mechanical Engineers. It represents the considered judgment of this Task Force, a group of engineers with expertise in these fields, rather than an official position of ASME.

TASK FORCE TO REVIEW THE 1991 DOE BUDGET REQUEST FOR CONSERVATION AND RENEWABLE ENERGY

Name and Address	AREA
Dr. Bill Beckman Professor and Chairman Department of Mechanical Engineering University of Wisconsin at Madison Madison, WI 53706	Solar Heating and Cooling
Dr. Arthur E. Bergles Dean of Engineering Rensselaer Polytechnic Institute Troy, NY 12180-3590	Energy Storage
Dr. Robert Boehm Professor Department of Mechanical & Industrial Engrg. The University of Utah Salt Lake City, Utah 84112	Geothermal
Dr. Ghazi Darkazalli Vice President Spire Corporation Patriots Park Bedford, MA 01730	Photovoltaics
Dr. Eric Farber Professor Emeritus Department of Mechanical Engineering University of Florida Gainesville, FL 32611	Solar Energy
Mr. Scott Patulsky Wisconsin Electric Power Company 4801 E. Elm Street Oak Creek, WI 53154	Hydro-Power
Dr. David Kearney Vice President Luz International Ltd. 924 Westwood Boulevard Los Angeles, CA 90024	Solar Thermal Power

Dr. Jan Kreider Director Joint Center for Energy Management University of Colorado Campus Box 428 Boulder, CO 80309-0428	Conservation and Solar Buildings
Dr. Frank Kreith ASME Legislative Fellow 1485 Sierra Drive Boulder, CA 80302	Conservation OTEC Solar Energy
Mr. Ken Nichols President Barber Nichols, Inc. 6325 W. 55th Avenue Arvada, CO 80002	Geothermal
Dr. Robert L. Reid Dean, School of Engineering Marquette University 1515 W. Wisconsin Avenue Milwaukee, WI 53233	Thermal Energy Storage and Solar Energy
Dr. Lee Stefanakos Chairman, Electrical Engineering Department University of South Florida Tampa, FL 33620	Photovoltaics
Dr. Andy Swift Department of Mechanical & Industrial Engrg. University of Texas at El Paso El Paso, TX 79968	Wind Energy
Dr. W. Dan Turner Associate Dean of Engineering Texas A&M University College Station, TX 77843	Conservation- Solar Buildings

Coordinators

Dr. D. Yogi Goswami
Professor of Mechanical Engineering
University of Florida
Gainesville, FL 32611

Dr. David Klett
Professor of Mechanical Engineering
N.C. A&T State University
Greensboro, NC 27411

Mrs. LLOYD. Thank you very much.

I don't know when we have ever had such great voting activity. It is pretty hard to keep any continuity in our hearings.

You mentioned your blue ribbon panel in setting priorities. To some extent, ERAB acts as an advisory panel. What is your opinion of ERAB?

Dr. GOSWAMI. Let me say first that I am not very much familiar with ERAB. I guess it is——

Mrs. LLOYD. The Energy Research Advisory Board.

Dr. GOSWAMI. When I mentioned the blue ribbon panel, the point I was trying to make was that the Department and the Congress need unbiased opinion from people that are experts but that may not have any vested interest and that may not feel limited or that may not feel constrained by what the feeling in the Department already is. It is possible that that may be ERAB. I am not very much familiar with it to say that it should be anything different from ERAB, but the point is that they do need to seek independent review.

The panel I would suggest would not only suggest priorities for the future but would also review the programs that are already in place.

Mrs. LLOYD. Let me ask you how you can have a working, on-hands knowledge of the programs, though, and not have somewhat of a vested interest. That would be pretty hard to do, wouldn't it?

Dr. GOSWAMI. It would be pretty hard to do that. However, our society, ASME, has been able to do that in the past. Let me give you an example. The DOE's Thermal Energy Storage Program was reviewed by ASME. We have an Office of Research and Technology Development in Washington, D.C., that set up the panel of experts not necessarily suggested by DOE, and they got these people at a place for two days where they just discussed that topic. They did invite some people from the program also, DOE's program, so that they could give their input to the process, and when they came out, they came out with some recommendations that were concrete.

Mrs. LLOYD. You know, we are hearing for the first time this year we have got a three-year funding mechanism, and we are pretty excited about that because it is the first time, Scott, that you have had three years to look forward to.

Mr. SKLAR. That is right.

Mrs. LLOYD. We thought that that was really a giant stride.

What level of increase would you recommend, Professor?

Dr. GOSWAMI. Instead of giving you a concrete figure of the level, let me say where the increase will be needed. I think that the technologies——

Mrs. LLOYD. Do you think photovoltaics and solar thermal——

Dr. GOSWAMI. Right—the photovoltaics and solar thermals, these are the technologies that have the potential in the near and the mid-term, and they need to be expedited, no doubt about it.

There are certain technologies that we need to bring to conclusion, that we are cutting off because the funds are not available. I think that is important. And then investments that have already been made by the Federal Government and the State governments, say, in the university research facilities that have been sitting idle.

I think investment needs to be made in there to make use of the investment that was already made.

Finally, we need to strengthen the infrastructure for future renewable energy research and development, which means that we need to strengthen the universities in terms of renewable energy research. Now, when you add that all up, I don't know what it comes to. I would tend to say that if you could get it back to the 1981 level, that would be great. However, I must say this, that I would never recommend increasing the money all of a sudden with no advanced planning at all, because in the past, in the late seventies and early eighties, we made some mistakes.

In 1981, I gave a paper at a textile industries' conference reviewing the Department of Energy's industrial process heat program, where the main theme was that most of the money was wasted, that some things that were done could have been done at 20 percent, and I proved that, that they could be done at 20 percent of the cost. Now here I was an advocate of solar energy, but yet I feel that being an advocate does not mean that you advocate waste of money.

So maybe an increase of 10, 15 percent—I think that should help.

Mrs. LLOYD. Would you gentlemen like to comment on that?

Dr. HIRST. I agree with the point about not wanting to waste money.

I had a concern with H.R. 1216 that I shared with Nancy. That authorization level there struck me as too low, and I think, given the fine words we heard from Mike Davis earlier, that is going to be a problem. I think funding levels could be increased at least 10 or 15 percent in terms of real dollars, which means if we have got inflation of 5 percent a year, it probably ought to be more like 15 or 20 percent a year. But I wouldn't want to make an across-the-board increase.

Mrs. LLOYD. As you know, that is going to be pretty tough.

Dr. HIRST. Probably. I think part of it ought to come out of other parts of the DOE budget.

Mrs. LLOYD. Now where? Now where?

Dr. HIRST. That is your job.

Mr. BUECHNER. It's your idea.

Mrs. LLOYD. Let's be specific, Doctor.

Dr. HIRST. If we are serious about addressing environmental problems, and if we are serious about economic productivity, then we have got to do it; I don't think there is any choice.

Mr. SKLAR. I think one way out of that, if I can cut in, is that some of these projects that DOE is involved with could be cost shared with some of the other Federal agencies—solar detoxification, for instance. There is no reason why EPA ought not to buy into some of this.

We—the solar industry, in cooperation with the Wind Association, is pushing for a training facility on solar and wind water purification and pumping technologies to train oversees people out of the agriculture appropriations, because that—water resources are an issue, and that may help our technology development. So there may be other ways we can cost share.

Mrs. LLOYD. I would like for you to provide some of this information for the record. In the meantime, we are going to go vote again.

[Recess.]

Mr. MORRISON [presiding]. I've got a couple of questions, so we will call the subcommittee back into hearing and proceed.

Scott, first of all, I appreciate your very scholarly dissertation. You are here often enough that you almost lecture to us, which is appropriate, I think.

I did want to raise a question concerning—you talked about end use being the thematic driver, if you will, in the reorganization, and you question that, I think, only from the point of view of the ability to track the funding and the activities. Yet you are also a strong supporter of, the best investment comes when, in fact, it is a partnership, you are tied with private enterprise in some way, and I presume that private enterprise is driven by end use.

Mr. SKLAR. Oh, yes. I want to make clear, I support the reorganization the way Secretary Davis set it up. I think it is an intelligent way to go. My caveat was, it is just going to be a little harder for the Congress and, in some cases, sometimes for us to track activity through that structure. That is a necessary evil, and I don't mean it in the harsh way, that you are going to have with that structure, but it is a good structure. I think it will do better for our programs to commercialize them.

So I have no problem with his approach. I endorse that approach quite strongly. I am just concerned where there are times when industry, sometimes the Congress, won't agree, and in that kind of structure it is a lot harder to track projects because they are so dispersed. That is the only point I wanted to make on that.

Mr. MORRISON. I think probably the bottom line on it is, we will count on a number of you that helped with the legislation and that have a tremendous level of interest in this activity, including groups like the American Society of Mechanical Engineers, as we make sure that we are getting the most out of this.

You also raised some questions about the detoxification project, saying that that didn't tie into any structure anywhere, but it still is a logical part of this organization.

Mr. SKLAR. Yes. They embedded it on the industrial side, which makes sense.

We support the research as an industry. I have had some discussions with Mr. Davis and with SERI regarding some of the ground work that needs to be done, some homework that needs to be done, before the Government should invest millions and millions of dollars in this, and I've gotten verbal support.

I do believe that an industry—we in industry are working very strongly also to get EPA to invest in this technology because it is an environmental clean-up technology. Mr. Davis and SERI have worked with some of the Federal facilities that generate wastes, and the Government has its own waste clean-up problems, as you know, and this technology, I think, they can play in the DOE framework really well.

So all I was saying is, one, it makes sense; we just have to make sure that there is controlled growth. Secondly, we disagreed in a little extent in terms of how much of the solar thermal money the administration proposed should go for detox. There has been a $4 million increase in the budget, but $8 million is being recommended for a detox initiative. SEIA believes that only $4 million, half

that much, ought to go to solar detox until some of this homework is done and that we ought to make good on the existing program, like some of the dish/engine technology and the advanced trough technology that we have invested in and we haven't seen some of the results. I am very concerned that we not stop midway in the midst of technology development for something new and meet our commitment.

So I support—SEIA supports detox very strongly. We think it ought to be in fiscal year 1991 at the $4 million level, and we also ought to broker EPA as a cofunder of this, as a way to bring in some other agencies as well.

Mr. MORRISON. I certainly concur with that. Perhaps they can be the partnership end of the relationship.

Mr. SKLAR. That is right.

Mr. MORRISON. You were very critical of the solar buildings cut which occurred and pointed out that 35 percent of energy costs were in buildings. Would that be a total building approach as you would see it, or is this just the application of some of the developments we have seen in solar energy work to building components, to building systems?

Mr. SKLAR. Well, the theory about moving the solar building technology essentially out of the renewable side of the funding base and into the community building system side was that solar technologies are part of a range of technological options—conservation, building design, solar water heating, certain kinds of space heating—and we agree with that.

I have no problem with what Mr. Davis is trying to do in terms of developing an integrated program for buildings, looking at all the options. It is a good idea. The problem comes in again in its implementation of that kind of reorganization. Does that mean that the $4 million of research that he has essentially cut—where does that go? Who does it? What is the three-year process?

Our industry has been working with HUD to get solar water heating applications, and our whole testing program that we have, a certification program, in the HUD FHA guidelines—what happens to that? What happens to the advanced glazing work that has come out of the active side of the program? What happens to this whole electro-chromic work? What happens to the solar cooling desiccant work that Florida Solar Energy Center has been working on for years that we think is about to enter into the private sector? And so the energy savings are real, but in terms of implementing the program right now, we may lose it. Now I am assured that that will not happen. I haven't seen any plans out of the agency to make sure that won't happen. So that is why we come to you.

But the savings potential of all of these technologies in the building sector is, you know, 20 to 25 percent range, so it is profound savings in the economy if we can pull this off.

Mr. MORRISON. You would agree with Dr. Hirst's suggestion that we have an efficiency code, so when you sell your house it would have a rating on it like a refrigerator?

Mr. SKLAR. There's a lot of mixed feelings in the marketplace. The home builder associations go crazy when that goes on, because they get nervous, and some of the programs used to determine energy efficiency aren't always necessarily sacrosanct. But I think

there ought to be some guidance to the consumer on homes that employ energy-conserving devices, and whether that is a rating or a certain kind of symbol if a certain threshold of energy savings is met, I think some kind of consumer education is a good idea.

Mr. MORRISON. Right now, the only rating system I know of is, "How much did it cost you to heat this place?"

Mr. SKLAR. That is right.

Mr. MORRISON. Dr. Goswami, did you have as a society any input into the proposed new energy strategy and also into Mr. Davis' restructuring of this part of the Department of Energy?

Dr. GOSWAMI. As a society, we did review the National Energy Strategy white papers that were sent to us. I don't know what happened with the reviews. We did send our reviews back to the Secretary of Energy.

As far as restructuring is concerned, I was not aware of it. This is the first time I have looked at it. If you want my opinion about it, I think end use should be a driving factor, no doubt about it. However, we have to be careful that in doing that we don't lose sight of the long-term benefits or long-term projects because they can get lost when you are only looking for shorter benefits.

Mr. MORRISON. Thank you.

Thank you, gentlemen. Thank you, Madam Chairman.

Mrs. LLOYD. Thank you very much, Mr. Morrison.

I apologize for the lengthy hearing, and we will be submitting questions in writing for you for the record, but in fairness to the next panel I think we had better move on.

Mr. SKLAR. And thank you, Madam Chairman.

Mrs. LLOYD. Your testimony is excellent.

Mr. SKLAR. We appreciate it. We appreciate the committee's support of the program, too.

Mrs. LLOYD. We are excited about all of your initiatives. As always, it is a pleasure to have you here.

Mr. SKLAR. Well, it is your work that made those initiatives come to be, so we appreciate it a lot. Thank you.

Mrs. LLOYD. Thank you so much.

Dr. GOSWAMI. Thank you.

Mrs. LLOYD. Our final panel consists of Dr. Robert Stokes, who is acting executive director of the Solar Energy Research Institute; Dr. Donald Klass, president of the Biomass Energy Research Association; and Mr. Randall Swisher, executive director of the American Wind Energy Association.

We are delighted to have you gentlemen with us, and, Dr. Stokes, I guess we will start this way again this time.

You messed me up a while ago.

Mr. MORRISON. I wanted him to go first as he used to be at Hanford.

Mrs. LLOYD. Well, good afternoon to you, and please proceed.

STATEMENT OF DR. ROBERT A. STOKES, CHIEF OPERATING OFFICER, SOLAR ENERGY RESEARCH INSTITUTE, GOLDEN, CO

Dr. STOKES. Thank you, Madam Chairman, members of the committee.

The Solar Energy Research Institute is located in Golden, Colorado, and has been managed since its formal beginning of operations in 1977 by the Midwest Research Institute of Kansas City, Missouri. SERI is DOE's principal laboratory for basic and applied research in solar and renewable energy. It is the only U.S. Federal laboratory devoted primarily to solar and renewable energy research. With a staff currently at about 500, it is also the world's largest renewable and solar energy research center, and the SERI staff not only perform basic and applied research in solar energy but we also do a great deal of program management on behalf of the Department of Energy, particularly conservation and renewable energy; we do a variety of analytic studies and technical evaluations of the potential economic drivers and integration issues related to renewable energy. In addition, we do quite a lot of collaborative research and development with both universities and with private industries using the entire spectrum of congressionally mandated technology transfer mechanisms, including, most recently, the cooperative research and development agreements; and finally, we, at the behest of Secretary Watkins and certainly before that, engage in very extensive educational activities more recently directed to high school and even preschool level.

Relating to the Department of Energy's fiscal year 1991 budget request for energy conservation and renewable energy programs, I'd like to provide the comments from SERI again with the background of the National Energy Strategy exercise which has occupied many of us within the Department of Energy for the last year.

Although this research and study effort is not complete, certainly as a result of both the extensive series of public hearings held by Secretary Watkins and his administrators and more recently as a result of an inter-laboratory white paper—in this case, the one on renewable energy which was developed by not only the Solar Energy Research Institute but by the Idaho National Engineering Laboratory, Los Alamos, Oak Ridge, Sandia, and by the Pacific Northwest Laboratories—the conclusions of both the hearings and the white paper, not surprisingly, very succinctly put, are that the best way to encourage the rapid introduction of renewable technologies is to substantially increase R&D funding. That sounds like a very simple conclusion, but, in fact, we compared that with the possibility of providing premiums, tax incentives, things of this sort, and we discovered that the R&D increases are actually more effective at increasing the rate and the levels of penetration of any of the technologies as they become economically competitive.

Now we at SERI are particularly encouraged by the fiscal year 1991 budget request because for at least the renewable energy part of the budget the Department's request represents a 27 percent increase over the level of funding in fiscal year 1990, and certainly we do applaud and encourage the emphasis that Secretary Davis has put in his renewable energy budget allocations. Namely, those emphases are on liquid transportation fuels from biomass, which we think has the potential for enormous impact in the transportation sector; the manufacturing for photovoltaics modules in conjunction with the U.S. photovoltaics manufacturing initiative; and certainly we think that within the DOE and eventually in the private sector there is enormous potential for this activity related to

the detoxification of hazardous chemicals using concentrated sunlight.

Related to these initiatives, it is important to remember that during the past decade, despite some reductions in funding, the R&D establishment within the DOE system and with its academic and industrial counterparts have achieved substantial progress toward the eventual goal of providing economic sources of solar and renewable energy. Perhaps even more importantly, the efforts have provided a much better understanding of the remaining technological hurdles which have to be overcome before there will be significant penetration beyond about the 9 percent level we see today in the U.S. for renewable technologies.

Some of the efforts where we have made tremendous gains in the past 10 years include the development of thin film photovoltaic modules, very high performance wind turbines, fast pyrolysis in chemical conversion of biomass, the anaerobic digestion of biomass you heard about earlier in the municipal solid waste testimony, the simultaneous saccharification and fermentation of cellulosic materials—it is a bit of a mouthful, but it is essentially a means by which we can convert about 90 percent of the waste from cellulosic or woody materials directly to ethanol, and we think this is, again, the reason why the emphasis is so important that you heard from Assistant Secretary Davis earlier. And, that goes hand in glove with that is the genetic engineering of biomass production in order to increase the dry production per acre from whatever land you devote to energy production.

We shouldn't forget the storage systems, long the Achilles heel, of the solar intermittent technologies have made great progress in the past 10 years as well, and we are beginning to understand how to really exploit the modularity of the systems like photovoltaics, the dish-Sterling solar thermal technology that has been alluded to earlier.

So, in summary, SERI certainly supports and applauds the definition of these conservation and renewable energy research initiatives. In fact, we view these initiatives as the centerpiece of DOE's energy efficiency and renewable programs for the next several years, and we expect to be very heavily involved in both the planning and implementation—in particular, of the initiative related to relighting the Federal facilities, the municipal solid waste initiative, the PV manufacturing technology, the ethanol fuels from biomass, and certainly I want to take the opportunity to applaud DOE's request for funds to begin construction of our badly needed laboratory building at SERI which will replace inadequate and even marginally safe leased facilities currently used for the conduct of our solar electric research and the research into the materials related to photovoltaics. This facility will not only give us additional space, permit larger equipment to be used in a much more effective operational mode because we will have isolated slabs on which we can place the sensitive optical equipment, but it will certainly permit us to operate in a manner more consistent with the required personnel health and safety requirements which we expect to follow in the future as our research level is increased.

I would like to just briefly comment on the reorganization of the Assistant Secretary's Conservation and Renewable Energy organi-

zation. Back to the National Energy Strategy, our inter-laboratory white paper projects as a base line an increase in primary energy demand for the United States from its current level of about 82 quadrillion Btu's to as much as 130 quads by the year 2030. That is a 60 percent increase in primary energy demand.

Whatever actually occurs—and you have heard from the conservation people who testified earlier that we hope that we can reduce that needed increase in energy—whatever increase occurs, it is important that as large a fraction as possible be provided by the environmentally benign solar and renewable energy technologies, and it is likely that the progress we can make in the future, as many of the previous speakers have said, can be better focused by looking at the end use consumers of energy in the United States. And of this 82 quads of current energy demand, about 35 percent goes to supply electrical utilities, about a quarter each to the transportation and industrial sectors, and about 17 percent to provide energy for our buildings. And we at SERI believe it isn't a particularly effective strategy to realign the programs so as to focus on each of these four end use energy consuming sectors.

I might just comment related to Congressman Wolpe's question earlier. We deliberately retained an organizational structure at the Solar Energy Research Institute which is focused not on the end use sectors but on the technical capabilities so as to be able to maintain technical centers of excellence in each of the fundamental and applied research and development areas. And we believe that this particular organizational structure at SERI along with the end use orientation at headquarters will provide an even more effective way of getting the job done, making sure particularly that the technology transfer and infrastructure development issues are dealt with but, at the same time, retaining the needed focus on research and development and not losing the momentum that we have gained over the past decade.

And just back to the issues of infrastructure and technology transfer and commercialization, it is important to remember that even when we reach these very aggressive cost goals which are laid out in the law—for example, when low cost pv modules are available to electrical utilities—there still remain rather daunting issues of system integration, how to deal with the intermittent nature of the resource, what is the optimum placement.

Certainly if we can make biomass-derived ethanol at prices competitive with the current prices of gasoline and diesel fuel, there remain a lot of barriers related to the availability of dedicated fuel vehicles, the necessary investment in fueling stations devoted to alcohols, so all of these issues are better dealt with by the current organization which names an Assistant Secretary for Technology Transfer—a Deputy Assistant Secretary for Technology Transfer and Commercialization.

So, in conclusion, we at SERI believe that accelerated research and development can certainly advance the day when the renewable energy technologies are in place to meet a substantial fraction of the Nation's primary energy need. I can't place a value on the acceleration, other than to point out the obvious thing to you, that the sooner we bring in the environmentally benign technologies the better, and we at SERI and at our sister laboratories within the

DOE system believe that the cost of accelerating the process of integrating renewable technologies is lower in the long run if we make the needed R&D investments up front and are able to proceed at a measured pace into the commercialization and technology transfer issues rather than wait until there is a crisis and we need to proceed on a variety of fronts perhaps at some inefficiency in the process, and we believe that, given the adequate resources on a timely basis, that we can, within the next few years, provide the private sector with an arsenal of renewable energy technologies to meet a substantial fraction, perhaps as much as 30 to 40 percent, of the Nation's primary energy supply by the year 2030, and we believe that we can do this in most instances at costs much lower than the current projections of the prices of the alternative equivalent supplies of fossil fuels.

Thank you very much.

[The prepared statement of Dr. Stokes follows:]

Testimony of Dr. Robert A. Stokes

Deputy Director and Chief Operating Officer
Solar Energy Research Institute

Before the
United States House of Representatives
Committee on Science, Space and Technology
Subcommittee on Energy Research and Development

June 6, 1990

Abstract

In the testimony that follows, I address several points:

- We are pleased with the Department of Energy's FY 1991 budget request because it will permit SERI to pursue important research projects that we believe can make significant contributions to the national renewable energy programs.
- SERI strongly supports the new DOE renewable energy initiatives and will be heavily involved in the planning and performance of many of them. We think the initiatives can be the centerpiece of the DOE's energy efficiency and renewable energy programs for the next several years.
- The realignment of the DOE conservation and renewable energy programs to focus individually on each of the four major end-use energy consuming sectors is the rationale for the recently-announced reorganization. We believe the changes will permit better integration of the various elements of the programs.
- The creation of the Office of Technical and Financial Assistance meets the need for addressing technology transfer issues that cut across the four end-use sectors.

The Solar Energy Research Institute

The Solar Energy Research Institute (SERI) was created by Congress in 1974. SERI formally began operations in July 1977 in Golden, Colorado. The Institute dedicated its first permanent building, the 80,000-square-foot Field Test Laboratory Building, in February 1984. The Department of Energy's (DOE) budget submission to Congress for FY 1991 recommends funding for a second major laboratory building.

The full-time permanent SERI staff totals 415, with another 70 part-time staff and visiting professionals. Scientists, engineers, technicians, and analysts account for 51% of the workforce.

SERI's Mission

SERI is DOE's principal laboratory for basic and applied research in solar and renewable energy conversion technologies. It is the only U.S. federal laboratory devoted primarily to renewable energy research and development. It is the largest solar energy research center in the world and the only research center addressing the complete spectrum of solar energy technologies. As such, the Institute is a unique national resource with a commitment to excellence and leadership.

SERI is the largest solar energy research center in the world and the only research center addressing the complete spectrum of solar energy technologies.

SERI is operated for DOE by Midwest Research Institute (MRI) of Kansas City, Missouri. As the nation's primary federal laboratory for solar energy research and development, SERI has several important functions:

- To perform basic and applied research in solar energy involving the physical, chemical, biological, and engineering sciences.
- To perform applied research and exploratory and advanced development in solar thermal, solar electric, solar fuels and related technologies, and in the evaluation of solar resources.
- To conduct field management responsibilities on behalf of DOE, including program integration, planning, and management of subcontracted research and development.
- To perform analytic studies and technology evaluations to support renewable energy research planning and to provide objective analyses of technical applications of research results.
- To serve as a source of scientific and technical information on renewable energy.
- To carry out collaborative research and development with universities and industry.

We work closely with other federal laboratories, universities, and the industrial community, ensuring a balanced input to program planning and broad dissemination and use of research results and technology.

- To provide researchers from industry, universities, and other federal laboratories access to SERI's specialized facilities and equipment for short-term research assignments.

Our education and training activities, in conjunction with U.S. schools at all levels, help to increase the number of scientists knowledgeable in solar science and technology.

We work closely with other federal laboratories, universities, and the industrial community, ensuring a balanced input to program planning and broad dissemination and use of research results and technology.

FY 1991 DOE Budget Request

The Subcommittee has invited SERI to comment on the Department of Energy's FY 1991 budget request for Energy Conservation and Renewable Energy Programs. We believe it would be valuable to provide our views on DOE's FY 1991 request within the broader context of the Department's National Energy Strategy, which is currently being developed. SERI and its sister laboratories have been significantly involved in the development of the strategy by virtue of our role in assessing the status and potential of renewable energy technologies.

FY 1991 DOE Budget Request

. . . we are encouraged by the Department's FY 1991 budget request, since it provides funding for existing programs and funds for addressing high-priority research projects that have been previously postponed.

Although the National Energy Strategy is not yet complete, public input to date reflects a broad consensus for increased emphasis on energy efficiency improvements and renewable energy. Similar views have been expressed in a white paper developed by several DOE laboratories as input to the National Energy Strategy. This report, *The Potential of Renewable Energy, an Interlaboratory White Paper* was compiled by experts at the Idaho National Energy Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Sandia National Laboratories, and the Solar Energy Research Institute. It concludes that the best way to push the technologies into the marketplace in a manner that would be most timely is to substantially increase R&D funding. Accordingly, we are encouraged by the Department's FY 1991 budget request, since it increases the government commitment to conservation and renewable energy research and development.

In particular, we strongly support the Department's emphasis on photovoltaics and renewable fuel technologies. We have often stated before this committee the need to reestablish U.S. leadership in photovoltaics technology by developing cooperative efforts with U.S. industry to bring laboratory advances more quickly into the marketplace.

In the renewable fuels area, a significant new biofuels initiative will accelerate our efforts to make ethanol an economically competitive fuel by using sources other than food crops as feedstocks. We also believe the Department's effort to make the combustion of municipal solid waste a key contributor to the nation's energy supply is a worthwhile endeavor.

Finally, we are, of course, delighted that the Department has requested a major new laboratory facility for SERI to improve safety and more effectively carry out the many scientific and engineering efforts needed to achieve the goals that will be established by the National Energy Strategy.

Stable, multiyear funding, as the current budget and Public Law 101-218 reflect, will help rekindle industry's interest in renewable energy and will lead a resurgence of both technological and commercial development. It will also help the R&D effort at SERI and at the other DOE laboratories. We can reemphasize some programs and revitalize others. We can retain top-quality researchers and professionals and attract new talent. Staff morale is on the rise. We can maintain our position as the world's leading center for renewable energy research, and that research will accelerate as results come more quickly. And so, we again express our appreciation to the committee for its support of the Public Law 101-218 and enlist its support for the FY 1991 budget request.

Stable, multiyear funding will help rekindle industry's interest in renewable energy and will lead a resurgence of both technological and commercial development.

SERI will be Significantly Involved in DOE's New Initiatives

SERI enthusiastically supports the new DOE initiatives. We will be heavily involved in the planning and performance of many of them. The initiatives demonstrate the administration's commitment to improve the nation's energy efficiency and to develop renewable energy technologies. We view the initiatives as the centerpiece of DOE's energy efficiency and renewable energy programs for the next several years.

SERI enthusiastically supports the new DOE initiatives. We will be heavily involved in the planning and performance of many of them.

The payoff from these efforts will be significant. For example, using energy more efficiently will also help us to avoid damage to the environment by eliminating an estimated 800 million tons of carbon dioxide, 2.3 million tons of sulfur oxides, and 2.1 million tons of nitrogen oxides annually. The avoided carbon dioxide emissions that result from these improvements in energy efficiency are steps that we can take now to reduce the threat of global climate change. Savings resulting from the energy efficiency initiatives alone, through the year 2000, could exceed $32 billion. And, these savings do not include the new energy that will be supplied by the renewable energy initiatives.

The new DOE initiatives include:

- Relighting federal facilities;
- Relighting commercial buildings;
- Improving utilities planning for efficiency;
- Accelerated building guidelines to standards;
- Energy analysis and diagnostic centers;
- Energy from municipal waste;
- Modern manufacturing technology for photovoltaics;
- Cost-competitive ethanol fuels;
- Speeding development of solar detoxification of hazardous wastes; and
- A new laboratory at SERI.

We view the initiatives as the centerpiece of the DOE's energy efficiency and renewable energy programs for the next several years.

I would like to briefly focus on those initiatives that SERI will have a substantial role in carrying out.

Relighting Federal Facilities

The objective of this initiative is to identify specific "showcase" opportunities in federal facilities for demonstrating improved building energy efficiency through the use of more efficient lighting. Approximately 25 percent of energy consumed in federal commercial buildings is used for lighting. A 25 percent increase in lighting efficiency could reduce the federal lighting bill by $930 million. Energy efficiency "teams" of engineers and design specialists, including SERI researchers, will conduct audits to identify and target buildings to retrofit with today's more efficient lighting technologies.

A 25 percent increase in lighting efficiency could reduce the federal lighting bill by $930 million.

Energy from Municipal Waste

The U.S. generates approximately 200 million tons of municipal solid waste each year. DOE plans joint ventures with industry to demonstrate advanced waste-to-energy technologies. Cost-shared cooperative ventures will include research on air emissions and ash management techniques for combustion facilities. DOE will also collect and publish data for the public and key decision makers on comparative economic, environmental and energy impacts of various waste-to-energy options. SERI research managers are currently working with DOE, EPA, DOD, and other labs to develop a plan for implementing this initiative.

Modern Manufacturing Technology for Photovoltaics

SERI is the lead laboratory for implementing the initiative to reduce the manufacturing cost of solar cells.

SERI is the lead laboratory for implementing the initiative to reduce the manufacturing cost of solar cells. The goal is to reduce the time required to transfer technology from the research laboratory to the private sector from 10 years to 6 years. We hope to accelerate photovoltaic manufacturing cost reductions and lay the foundation for large-scale production. By targeting

firms with manufacturing lines, commercial products, and corporate commitments, we hope to guarantee a world leadership role for U.S. industry.

Cost-Competitive Ethanol Fuels

With proper management of our renewable resources, we believe that we could eventually produce enough ethanol per year to replace current gasoline without adding to the greenhouse effect.

We believe that among all the renewable energy technologies, biofuels may offer America its greatest promise. DOE has proposed and coordinated a public-private effort to make ethanol fuels from non-food feedstocks a fully competitive alternative fuel by the turn of the century. DOE will work with the Department of Agriculture on crop development to provide additional farm income and with its own laboratories, including SERI, on conversion process development. In addition, close coordination with the private sector will be maintained for technology transfer and commercialization. With proper management of our renewable resources, we believe that we could eventually produce enough ethanol per year to replace gasoline at current usage rates without adding to the greenhouse effect.

Solar Detoxification of Hazardous Wastes

Recent laboratory results demonstrate that concentrated solar energy can break down many toxic chemicals, including dioxins and PCBs, into harmless by-products with greater efficiency than that required by EPA standards. This initiative will speed up prototype testing and development of the technology, conduct experiments at contaminated federal sites, and establish cooperative agreements with other agencies and private industry involved in the cleanup of such sites.

New Laboratory at SERI

DOE has proposed a $19.6 million, 98,000-square-foot, government-owned laboratory building at SERI's facilities in Golden, Colorado. The new facility would be our principal laboratory for photovoltaic and solar heat technologies research. It will replace our currently inadequate leased facilities. For example, the new design will permit our use of vibration-sensitive equipment without concern for resulting vibrational and structural impacts beyond equipment rooms. In addition, the new design will enable us to more effectively control toxic fumes and chemical exhausts in our air system, reducing the risk of widespread contamination.

Perhaps most importantly, this new building will help signal the nation's renewed commitment to expanding renewable energy's contribution to our energy future.

In short, SERI is enthused about the new DOE initiatives in energy efficiency and renewable energy. We are excited about our role in leading or significantly contributing to the achievement of these initiatives over the next several years.

SERI has a Favorable View of the Reorganization of DOE's Office of the Assistant Secretary, Conservation and Renewable Energy

The Department of Energy's National Energy Strategy baseline projections indicate that U.S. primary energy demand is likely to increase from its current level of 82 quads to 132 quads by 2030.

The Department of Energy's National Energy Strategy baseline projections indicate that U.S. primary energy demand is likely to increase from its current level of 82 quads to 132 quads by 2030, an approximately 60% increase. Whatever increase in demand actually occurs, it is important that as large a fraction as possible of this increase in supply come from economically competitive renewable energy technologies. Renewable technologies are generally considered benign with respect to their environmental impacts, and the energy supplies are largely indigenous, as in the case of photovoltaic- or wind-generated electricity or biomass-derived transportation fuels. In our future attempts to reduce demand for energy through improvements in energy efficiency, it is likely that we will achieve the greatest success by focusing our efforts separately on each end-use sector: electricity, transportation, industry, and buildings.

. . . realigning programs to focus individually on each of these four major end-use energy consuming sectors . . . is the intent of the recently announced reorganization of DOE's Office of Conservation and Renewable Energy . . .

Of the 82 quads of current primary energy demand, 35% goes to supply electrical energy, 27% to the transportation sector, 23% to industry, and 17% to provide energy for our buildings. A particularly effective approach for increasing the use of renewable energy and improving the efficiency of energy use is to realign programs to focus individually on each of these four major end-use energy-consuming sectors. This is the intent of the recently announced reorganization of DOE's Office of Conservation and Renewable Energy (CE) in which a deputy assistant secretary has been named for utility technologies, industrial technologies, transportation technologies, and buildings technologies. This new structure is designed to permit DOE conservation and renewable energy programs to restructure so as to deal most effectively with the three important issues of energy supply, demand reduction, and infrastructure development in each end-use area.

The area of infrastructure development is particularly important, since even when our cost goals for various renewable energy technologies are met, there will remain daunting barriers to their large-scale introduction. For example, even when very low-cost photovoltaic modules are available, electrical utilities will need to develop deployment strategies that take into account the intermittent nature of the solar resource and the optimum size and placement of

32-540 - 90 - 4

generation capacity within the transmission and distribution grid. Even if biomass-derived ethanol were available at costs comparable to those for gasoline and diesel fuel, a large-scale shift to alcohol fuels will depend on the availability of dedicated fuel vehicles specifically designed to take advantage of the higher compression ratios and lighter weight possible with alcohol fuels and also on convenient access to fueling stations.

In recognition of the importance of technology transfer, the new CE organization has established an Office of Technical and Financial Assistance, which will be concerned with technology transfer issues that cut across the four end-use sectors.

Successful commercialization of the renewable technologies is therefore critical to our ability to meet the challenge of energy supply for the future. In recognition of the importance of technology transfer, the new CE organization has established an Office of Technical and Financial Assistance, which will be concerned with technology transfer issues that cut across the four end-use sectors.

Finally, an Office of Planning and Assessment has been created to allow CE to develop more effective strategies for coordinating the various technology programs with the needs of the ultimate users, as well as to identify and evaluate a variety of technological, economic, and environmental factors in planning future CE research programs.

SERI believes these changes provide a number of benefits to the effective implementation of the DOE R&D programs in conservation and renewable energy. They should also enhance programmatic interactions with the various DOE R&D laboratories.

Mrs. LLOYD. Thank you, Dr. Stokes.
Dr. Klass, we will hear your testimony now.

STATEMENT OF DR. DONALD L. KLASS, PRESIDENT, BIOMASSS ENERGY RESEARCH ASSOCIATION, WASHINGTON, DC

Dr. KLASS. Thank you, Madam Chairman and members of the subcommittee. We appreciate the opportunity of appearing before you again to present our recommendations for the Department of Energy biomass and municipal solid waste research budget and also, as requested, to present our views on DOE's reorganization plan and the proposed new initiatives for conservation and renewable energy.

Before presenting BERA's position, I would just like to point out that biofuels can provide strong contributions to the recently announced National Energy Strategy; they can help clean up the environment and make major contributions to energy security and economic growth. The first two pages of my statement present more detail on our views on this subject, so I urge you to read this document when you have the opportunity.

Regarding DOE's efficiency and renewable energy initiatives announced on January 26 of this year, I would like to present our concerns about a few of them. While the proposed initiatives are sound ideas that will promote cost-effective energy savings, I must question whether some of the initiatives are truly research and whether some are appropriate for the Government to undertake.

The matter of relighting Federal facilities utilizing advanced lighting technologies, for example, is clearly a sound idea, the implementation of which will serve as an example of cost-effective energy savings, but it is simply good management using current technology and knowledge and should not be labeled a new initiative in DOE research.

Similarly, the announced initiatives for relighting commercial buildings and accelerated building guidelines and standards are perhaps of questionable value as Federal research. On the other hand, the initiative on integrated resource planning is clearly needed and is excellent example of an appropriate Federal role. Identifying regulatory barriers to conservation and renewable technologies and developing workable alternatives to those barriers would be a valuable service for the country.

The initiative to expand DOE's research on the production of ethanol fuel from domestic nonfood resources and to include cost-share joint ventures presumably with industry on this subject is also a good example of an appropriate Federal role.

Regarding conservation and renewable energy program reorganization by DOE, the new organizational charts provided to us by DOE and discussions with DOE staff indicate that conservation and renewable energy now consist of five offices: the offices of utility technologies, industrial technologies, transportation technologies, building technologies, and technical and financial assistance. The biomass projects managed by the former Biofuels and Municipal Waste Technology Division currently reside in five divisions within four of these five offices. This management structure is designed around end uses of the energy or fuel products produced from bio-

mass. DOE personnel believe that the end use approach will make biofuels technologies more user friendly, enable a focused effort on the development of selected biofuel systems, and help to increase industry involvement.

But it is probable that the emphasis on end use will also shift most of the research to short-term goals and objectives. It is also possible that efficient management of biomass research under this new structure will be difficult because additional DOE personnel are involved, some of whom have little or no experience on the subject matter of their new assignments. Some of the research projects may also fall through the cracks because of the increased bureaucracy.

However, it is premature to render judgment on the precise impact of the reorganization on the value and productivity of DOE's renewable energy research. We recommend that a sufficient period of time be given to allow the benefits to be evaluated. Based on 30 years of personal experience in planning, managing, and consulting on a variety of energy research programs, I believe the end use approach to managing the biomass energy program is worthy of consideration. This approach may indeed result in increased industry involvement, which would be a major accomplishment particularly for biofuels.

As I pointed out before, the biofuels industry consists of many unrelated industries, such as, for example, the fuel ethanol industry and the landfill methane recovery industry, whose biofuels have different end uses.

Management of biofuels research around end use may indeed increase commercial utilization of the research results. Time will establish whether reorganization of the conservation and renewable energy research program is an advancement or a step backward. We recommend that Congress reevaluate the effects of reorganization in 12 to 18 months.

Now regarding the fiscal year 1991 budget request for biofuels, we have reviewed DOE's proposed fiscal year 1991 $28 million research budget and are pleased to note that a significant increase in their request to Congress has occurred compared to the fiscal year 1990 request. The DOE request for fiscal year 1991 includes for the first time a specific line item for regional programs established by Congress in 1983. It also includes a line item for hydrogen research that has little or no relationship to biofuels. These programs have been directed to be funded by Congress without a corresponding increase in the budget in past years, and inclusion as line items will enable the core biofuels programs to be maintained without major program reductions and terminations.

BERA strongly recommends that a majority of the research funds appropriated for fiscal year 1991 be contracted to organizations other than the national laboratories. This recommendation is in line with the DOE Energy Research Advisory Board's analysis of DOE's solar energy research program in 1985. This will allow independent U.S. scientists and engineers involved in biofuels research to maintain their skills and improve their expertise and for the Nation to maintain a competitive technological position in the development of alternative fuels.

The remainder of my statement summarizes our recommendations on the research areas and the funding levels we urge you to include in the fiscal year 1991 program. We recommend that demonstration projects be added to the research program so that industry cost-shared scale-up work can be initiated as early as possible to ensure industry participation and transfer of the research results to the private sector.

I would like to point out that the industry cofunded medium Btu gasification demonstration plant that BERA has supported for several years is not yet under contract. Five million dollars have already been separately appropriated for the scale-up program and will therefore not affect the budget for fiscal year 1991. We strongly believe that this project be initiated as soon as possible.

About one-half of our budgetary recommendation, excluding BERA's scale-up recommendations of $11 million, is again allocated to conversion because we believe that it is the foundation of a balanced program to develop innovative systems for the production of clean, solid, liquid, and gaseous biofuels.

We continue to believe the real potential of biofuels can never be realized without development of efficient, economic conversion processes. Our recommendations comprise a balanced program of production and conversion research and technology transfer to the private sector with emphasis on end uses such as alternative liquid transportation fuels and on innovative municipal solid waste disposal energy recovery systems having superior environmental benefits and minimal emissions.

In the area of biomass production, we recommend that the work be continued as an integral part of the biofuels program. It is recommended that research on aquatic biomass be minimized, that emphasis be given to terrestrial biomass species of trees and grasses, and that the level of funding for fiscal year 1991 be $5,700,000.

In thermo-chemical conversion, our members feels that research on biomass and municipal solid wastes should be funded equally. MSW disposal is a nationwide problem that needs our immediate attention while biomass offers a long-term approach to development of large-scale supplies of biofuels. We recommend that $8,900,000 be directed to continue thermo-chemical conversion research on biomass and municipal solid wastes.

In biochemical conversion, application of the rapidly advancing field of biotechnology to the conversion of low-cost biomass to liquid and gaseous fuels, such as ethanol and methane-containing fuel gases, has made great progress and should be continued. We recommend that $7,600,000 be directed to continue biochemical conversion research for liquid and gaseous biofuels production.

Now the regional programs established by Congress in 1983 are implemented through five separate regions and should be sustained, in our judgment, to help transfer research results to the end users. We recommend that funding be provided for the regional programs at a level of $5 million for fiscal year 1991.

One of the difficulties encountered in commercializing biofuels technology is that industry has not utilized much of the research information developed in this program. We therefore strongly recommend that specific scale-up projects be initiated with industry

involvement and cost sharing. We urge that at least one scale-up demonstration project be started in fiscal year 1991 in addition to the medium Btu gasification demonstration that should be under way in fiscal year 1990 and that at least one new demonstration project be funded each year thereafter. A first year budget of $11 million is recommended for this work.

Over the last few years, a continually reduced appropriation has made it extremely difficult for DOE to sustain a balanced research program. A high proportion of a limited budget allocated to earmark projects and expansion of the biofuels program to include nonbiofuels research without corresponding budgetary additions caused major program reductions. BERA strongly urges Congress, therefore, to appropriate a budget of $38.2 million, as I have indicted, for fiscal year 1991 and an additional $800,000 for capital equipment.

Finally, regarding program planning, DOE's first multi-year plan for biofuels R&D was published in fiscal year 1989. We recommend that the plan be updated in fiscal year 1991 and that the program elements described in this plan should be related to past, present, and planned funding levels.

So we thank you very much, Madam Chairman, for the opportunity to make our presentation.

[The prepared statement of Dr. Klass follows:]

Hearing on Department of Energy FY1991 Budget Submission
for Conservation and Renewable Energy Programs

Statement of Dr. Donald L. Klass, President
Biomass Energy Research Association

Before the House Committee on Science, Space, and Technology
Subcommittee on Energy Research and Development
June 6, 1990

Thank you Madame Chairman and members of the Subcommittee. My name is Donald Klass. I am President of BERA. BERA is a non-profit association that was founded in 1982 by biofuels researchers and companies that are conducting biofuels research. Our objectives are to promote education and research on renewable biomass- and waste-to-energy systems that can be economically utilized by the public, and to serve as a source of information on policies and programs for our members and industry.

We appreciate the opportunity to appear before you again to present BERA's recommendations for the Department of Energy (DOE) biomass and municipal solid waste research budget, and also to present our views on DOE's reorganization plan and the proposed new initiatives for Conservation and Renewable Energy.

Before presenting BERA's position, I would briefly like to point out how biofuels can provide a strong contribution to the recently announced National Energy Strategy.

Biofuels Can Help Clean-Up Environment

Because of recent activity on new federal clean-air legislation, it is important to emphasize the role that biofuels can play in achieving a cleaner environment. Usage of biofuels, such as methanol, ethanol, and other oxygenated biomass derivatives, can have a strong beneficial impact on air quality, particularly as alternative liquid transportation fuels.

- The extremely low sulfur content of biomass results in little or no SO_x emissions, a precursor of acid rain.

- Oxygenated biofuels emit very little NO_x, a necessary reactant in the formation of ozone (smog).

- Application of biofuels technologies to waste offers opportunities for combined waste disposal-energy recovery-conservation systems.

As I pointed out last year, there is little doubt that the growth of biomass is the only practical way to remove CO_2 from the air and ameliorate global warming, and that biofuels are the only energy technologies that can both remove atmospheric CO_2 and reduce the amount of fossil fuels burned. In addition, displacement of fossil fuels by biofuels can eliminate or reduce atmospheric SO_2, NO_x, ozone, and unburned hydrocarbon fuels, all of which contribute heavily to sub-quality air.

Relationship to Energy Security

- The widely dispersed nature of biomass for biofuels greatly improves our national security by providing a secure energy supply.

- Biofuels are the only renewable energy supply from local resources capable of supplying substitutes for fossil-derived liquid, gaseous, and solid fuels, as well as heat and electricity, to all areas of the Nation and to all four sectors of the energy economy -- residential, commercial, industrial, and transportation.

- In 1988, biofuels contributed about 3.2 quad (1.5 million barrels of oil equivalent per day) of energy in all forms, or about 3.8% of our national total primary energy demand of about 83 quad, and have been projected to contribute 10.1 quad in 2010.

- The energy potentially available each year from biomass and wastes about the turn of this century has been estimated to range up to 54.9 quad, or about one half of U.S. projected energy consumption at that time.

- Municipal, industrial, and agricultural wastes are currently estimated to have an energy potential of about 15.0 quad per year, and wood and wood wastes are currently estimated to have an energy potential up to about 25.0 quad per year.

- Utilization of excess capacity croplands of up to 160 million acres projected beyond the year 2000 could produce up to 10.2 quad per year of energy crops. This could open the way to new food, feed, and fuel product flexibility to provide more stability to market prices, create new markets for the agricultural sector, and reduce federal farm subsidy payments.

- Virtually all basic organic chemicals -- including plastics and petroleum-derived products -- can be manufactured from biomass and wastes thereby displacing and conserving depletable fossil feedstocks.

Relationship to Economic Growth

- Biofuels are the only renewable resource that can provide desperately needed local jobs and economic development nationwide for the American farmer.

- At a price of $20 per barrel of oil equivalent, biofuels currently retain in the U.S.A. about $11.0 billion per year that are not expended on oil imports thereby having a strong beneficial impact on our massive trade deficit.

- Biofuels provide excellent regional benefits -- 80 cents of every dollar spent on biofuels in a given region stays in that region, while 80 cents of every dollar spent on petroleum leaves the region.

- Industrial utilization of biofuels supplies local jobs and income such as the 57,000 jobs and $878 million in income in the Southeast that resulted from fuel wood usage in 1988, both of which are projected to double by the year 2000.

DOE'S EFFICIENCY AND RENEWABLE ENERGY INITIATIVES

DOE's recent increased focus on Conservation and Renewable Energy programs is sincerely appreciated by the biomass research community and, I am sure, by all renewable energy researchers. This additional support from the Government is of vital importance to the development of advanced technologies and concepts that will play a significant role in our energy future.

Although only two of the eleven initiatives announced by DOE on January 26, 1990, relate to biofuels, I would like to present our concerns about a few of them. While the proposed initiatives are sound ideas that will, when implemented, promote cost-effective energy savings, I must question whether some of the initiatives are truly research and whether some are appropriate for the Government to undertake.

The matter of relighting Federal facilities utilizing advanced lighting technologies, for instance, is clearly a sound idea, the implementation of which will serve as an example of cost-effective energy savings. But it is simply good management using current knowledge and technology, and should not be labeled a "new initiative" in DOE research. Similarly, the announced initiatives for relighting commercial buildings and accelerated building guidelines and standards are perhaps of questionable value as Federal research.

On the other hand, the initiative on integrated resource planning is clearly needed and is an excellent example of an appropriate Federal role. Identifying regulatory barriers to conservation and renewable technologies and developing workable alternatives to those barriers would be a valuable service to the Nation. The proposal to develop a nationwide set of standards to quantify the costs and impacts of environmental and economic externalities would be extremely useful in helping this country establish an accurate sense of the true costs of energy options. An understanding of those costs would be a significant boost to the public acceptance and implementation of renewable energy technologies.

The initiative to expand DOE's research on the production of ethanol fuel from domestic non-food resources and to include cost-shared joint ventures, presumably with industry, on this subject is also a good example of an appropriate Federal role.

CONSERVATION AND RENEWABLE ENERGY PROGRAM REORGANIZATION

The new organizational charts provided to us by DOE and discussions with DOE staff indicate that Conservation and Renewable Energy now consists of five offices -- the Offices of Utility Technologies, Industrial Technologies, Transportation Technologies, Building Technologies, and Technical and

Financial Assistance. The biomass projects managed by the former Biofuels and Municipal Waste Technology Division currently reside in five divisions within four of these five offices. It is our understanding that the biomass projects have been distributed as shown in the accompanying chart.

Current Location in Conservation & Renewable Energy of Biomass Projects

Office	Division	Research Area
Utility Technologies	Solar Thermal & Biomass Power	Medium-Btu Gasification Scale-Up, Thermochemical Conversion
	Utility Systems	Hydrogen
Industrial Technologies	Waste Material Management	Thermochemical Conversion and Anaerobic Digestion of MSW
Transportation Technologies	Biofuels Systems	Alcohol Fuels and Biomass Production
Technical & Financial Assistance	State Energy Management Programs	Regional Programs

This management structure is designed around end uses of the energy or fuel products produced from biomass. DOE personnel believe that the end-use approach will make biofuels technologies more user friendly, enable a focused effort on the development of selected biofuels systems, and help to increase industry involvement. But it is probable that the emphasis on end use will shift most of the research to short-term goals and objectives. It is also possible that efficient management of biomass research under this new structure will be difficult because additional DOE personnel are involved, some of whom have little or no experience in the subject matter of their new assignments. Some of the research projects may also "fall through the cracks" because of the increased bureaucracy.

However, it is premature to render judgment on the precise impact of the reorganization on the value and productivity of DOE's renewable energy research. We recommend that a sufficient period of time be given to allow the benefits to be evaluated. Based on 30 years of personal experience in planning, managing, and consulting on a variety of energy research programs, I believe the end-use approach to managing the biomass energy program is worthy of consideration. This approach may indeed result in increased industry involvement, which would be a major accomplishment, particularly in the case of biofuels. As I have pointed out before, the biofuels industry consists of many unrelated industries such as, for example, the fuel ethanol industry and the landfill methane-recovery industry, whose biofuels have different end uses. Management of biofuels research around end use may indeed increase commercial utilization of the research results. Time will establish whether reorganization of the Conservation and Renewable Energy research program is an advancement or a step backward. We recommend that Congress reevaluate the effects of reorganization in 12 to 18 months.

BERA RECOMMENDS $39.0 MILLION FOR FISCAL 1991 BIOFUELS RD&D
A Balanced Program of Production, Conversion, and Technology Transfer

We have reviewed DOE's proposed fiscal 1991 $28.0-million research budget, and are pleased to note that a significant increase in their request to Congress has occurred compared to the fiscal 1990 request. The DOE request for fiscal 1991 includes, for the first time, a specific line item for the Regional Programs established by Congress in 1983. It also includes a line item for hydrogen research that has little or no relationship to biofuels. These programs have been directed to be funded by Congress without a corresponding increase in the budget in past years, and inclusion as line items will enable the core biofuels program to be maintained without major program reductions and terminations.

BERA strongly recommends that a majority of the research funds appropriated for fiscal 1991 be contracted to organizations other than national laboratories. This recommendation is in line with the DOE Energy Research Advisory Board's analysis of DOE's solar energy research program in 1985. This will allow independent U.S. scientists and engineers involved in biofuels research to maintain their skills and improve their expertise, and for the Nation to maintain a competitive technological position in the development of alternative fuels.

The following represents BERA's recommendations on the research areas and the funding levels we urge you to include in the fiscal 1991 program. We recommend that demonstration projects be added to the research program so that industry cost-shared scale-up work can be initiated as early as possible to ensure industry participation and transfer of the research results to the private sector. I would like to point out that the industry co-funded medium-Btu gasification demonstration plant that BERA has supported for several years is not yet under contract. Five million dollars have already been separately appropriated for the scale-up program and will therefore not affect the budget for fiscal 1991. BERA strongly urges that this project be initiated as soon as possible.

About one half of our budgetary recommendation, excluding BERA's scale-up recommendations of $11 million, is again allocated to conversion because we believe that it is the foundation of a balanced program to develop advanced innovative systems for the production of clean solid, liquid, and gaseous biofuels. We continue to believe the real potential of biofuels can never be realized without development of efficient, economic, conversion processes.

Our recommendations comprise a balanced program of production and conversion research and technology transfer to the private sector with emphasis on end uses such as alternative liquid transportation fuels and on innovative municipal solid waste disposal-energy recovery systems having superior environmental benefits and minimal emissions.

I would now like to summarize BERA's biofuels recommendations for fiscal 1991.

Biomass Production

Land and/or water-based biomass grown and harvested specifically for biofuels represents a long-term approach to energy plantations that can supply large amounts of fossil fuel substitutes. Considerable progress has been made on efficient short-rotation intensive-culture tree production methods, and on the growth of herbaceous species. Considerable progress has also been made on development of "wood grass," in which carefully chosen tree species are grown in close-spaced plantings and harvested like a perennial grass over short rotations. In addition, research on tissue culture techniques and the application of genetic engineering methods to low-cost energy crop production have shown promise. This work should be continued as an integral part of the biofuels program. It is recommended that research on aquatic biomass be minimized and that emphasis be given to terrestrial biomass species of trees and grasses.

BERA recommends that $5,700,000 be directed to continue biomass production research.

Thermochemical Conversion

Thermochemical conversion research to produce energy and clean solid, liquid, and gaseous biofuels at competitive costs is the prime target of this program component. Laboratory- and pilot-scale research on municipal solid wastes and biomass has established the technical feasibility of several advanced combustion, gasification, and liquefaction processes, and basic research has improved our understanding of the mechanisms of conversion and the formation of pollutants, especially from municipal solid waste-energy recovery facilities. Future research should emphasize end uses such as alternative transportation fuels, efficient solid waste disposal-energy recovery processes, and fuels for clean-burning wood stoves, fireplaces, and furnaces.

In combustion research, a need still exists for improved solid waste incinerators that meet environmental requirements and cost goals. Research should be focused on systems that can be used for economic disposal of municipal solid wastes in small communities. Research is also needed to reduce the emissions of solid waste disposal processes and to characterize the specific pollutants produced under specific operating conditions.

Continued research on the thermochemical gasification of wastes and biomass has resulted in the development of advanced process designs and reactor configurations that maximize yields and provide optimum product distributions. For example, selected operating conditions can produce medium-Btu gas or optimum synthesis gases for manufacture of ammonia, methanol, methane, gasoline, or diesel fuels. This work has been performed at the laboratory and pilot scales and is ready for demonstration. Some research is still needed to perfect the feeding of diverse biomass and waste feedstocks at elevated pressures, the elimination of tars and particulates from product gas streams, the recycling of residuals, and the effects of oxygen-starved conversion on toxic metal emissions.

Direct conversion of municipal solid wastes, wood, and herbaceous feedstocks via pyrolysis to liquid fuels and their upgrading by advanced catalytic processes to transportation fuels show promise. Continued research is expected to increase the overall liquid yields to the point where the gasoline costs are competitive with those of petroleum-based liquids. Thermochemical liquefaction of wastes and low-grade biomass for the production of low-cost fuel ethanol or mixed alcohols also shows promise and merits investigation.

BERA's members feel that thermochemical conversion research on biomass and municipal solid waste should be funded equally. Municipal solid waste disposal is a nationwide problem that needs our immediate attention, while biomass offers a long-term approach to development of large-scale supplies of biofuels.

BERA recommends that $8,900,000 be directed to continue thermochemical conversion research on biomass and municipal solid wastes.

Biochemical Conversion

Application of the rapidly advancing field of biotechnology to the conversion of low-cost biomass to liquid and gaseous fuels such as ethanol and methane-containing fuel gases has made great progress and should be continued. Process evaluations by experts have identified key opportunities for economic pay-backs with biochemical conversion systems, and new genetic engineering and other emerging biological approaches have made significant advances. Research needs have also been identified that should be addressed to increase our understanding of the biochemical and microbial interactions that occur in fermentation processes.

At this time, the cost of ethanol from lignocellulosic biomass is approaching that from corn, and with continued research, we are confident the cost can be made competitive with fuels at today's prices without tax exemptions, thereby lessening our dependence on foreign supplies of petroleum while stabilizing fuel prices. Furthermore, the technical advances made through this program will benefit the competitive position of the United States in biotechnology world markets. Future research should be concentrated on conversion of low-cost feedstocks such as lignocellulosic wood wastes by high-yield acid- and enzyme-catalyzed hydrolysis processes, on development of innovative fermentation product separation schemes that have the capability of producing low-cost fuels and by-products, on the development of organisms that can metabolize the hemicellulose components in the feedstocks, and on the utilization of the lignin fractions as octane enhancers and chemicals.

Research on the use of genetically engineered bacteria that can produce ethanol from low-cost feedstocks at higher rates and yields should be incorporated in the program. In addition, research should be performed on the development of innovative processes for the production of butyl alcohols so that methyl-t-butyl ether (MTBE) and ethyl-t-butyl ether (ETBE) gasoline additives can be manufactured totally from biomass without use of petroleum.

Biochemical conversion systems are unique in that they can directly produce methane, the major component of natural gas, from the full range of low-cost biomass. Research is needed to develop novel systems that permit higher feedstock concentrations and smaller reactor volumes, and therefore lower capital costs. This research is expected to lead to practical methods for economic production of methane from low-cost biomass. And in the case of feedstocks such as municipal wastewaters, low-cost integrated biomass production-waste stabilization-methane production systems are expected to evolve from continued research.

BERA recommends that $7,600,000 be directed to continue biochemical conversion research for liquid and gaseous biofuels production.

Regional Programs

The Regional Programs established by Congress in 1983 are implemented through five separate regions and should be sustained to help transfer research results to end users. The five regions -- Northwest, West, Great Lakes, Northeast, and Southeast -- have similar objectives, chief among them being the utilization of biofuels technologies by the private sector using local resources.

BERA urges that funding be provided for the Regional Programs at $5,000,000.

Demonstration Programs

One of the difficulties encountered in commercializing biofuels technology is that industry has not utilized much of the research information developed in this program. It is therefore strongly recommended that specific scale-up projects be initiated with industry involvement and cost sharing. The BERA Board of Directors recommends that the first of these demonstration projects be selected from these subjects: Methanol Production from Medium-Btu Biomass Gasification Technology, Ethanol Production from Best Available Lignocellulose-Based Technology, Electric Power Production from High-Efficiency Biomass-Fueled Gas Turbines, Municipal Solid Waste Disposal-Energy Recovery by Best Available Technology, Pyrolytic Liquid Fuel Production by Best Available Technology, Biomass Gasification-Molten Carbonate Fuel Cell Cogeneration Systems, and Large-Scale, Short-Rotation, Intensive-Culture Tree or Wood Grass Field Demonstrations. It is recommended that at least one scale-up demonstration project be started in fiscal 1991, in addition to the medium-Btu gasification demonstration that should be underway in fiscal 1990, and that at least one new demonstration project be funded each year thereafter.

A first-year budget of $11,000,000 is recommended for this work.

Recommended Budget

Over the last few years, a continually reduced appropriation has made it extremely difficult for DOE to sustain a balanced research program. A high

proportion of a limited budget allocated to earmarked projects and expansion of the biofuels program to include non-biofuels research without corresponding budgetary additions caused major program reductions. BERA strongly urges Congress, therefore, to appropriate a budget of $38.2 million as allocated above for fiscal 1991, and an additional $0.8 million for capital equipment.

Program Planning

DOE's first multiyear plan for biofuels R&D was published in fiscal 1989. BERA recommends that the plan be updated in fiscal 1991 and that program elements described in the plan should be related to past, present, and planned funding levels.

Mrs. LLOYD. Thank you very much for an excellent presentation. Mr. Swisher, thank you for being here as well. Please proceed.

STATEMENT OF RANDALL SWISHER, EXECUTIVE DIRECTOR, AMERICAN WIND ENERGY ASSOCIATION, ARLINGTON, VA

Mr. SWISHER. I appreciate the opportunity to be here on behalf of the American Wind Energy Association.

Let me summarize my extensive written statement in regard to the current status of wind energy and then comment on the reorganization and the budget.

Mrs. LLOYD. Very good, and all of your statements in their entirety will be made a part of the record.

Mr. SWISHER. Thank you very much.

Wind has a tremendous potential. In 37 of the 50 States, there is sufficient wind energy for utility grade applications which conservatively could provide as much as one trillion kilowatt hours annually were we to actually achieve all that potential. There are currently 15,000 turbines operating in Hawaii and California delivering 1,400 megawatts of capacity and, last year, over 2.2 billion kilowatt hours.

Performance has increased tremendously over the decade. As you are no doubt aware, it was a shaky start. In the early parts of the 1980's, technical failure was common. That is no longer the issue. I am glad to say that reliability in the major wind operations in California—I just returned from 10 days there, and for the major operators between 98 and 99 percent availability for turbines; that's a major step forward over where we were just five years ago.

Costs also have shown tremendous improvement. In 1981, wind energy was generating electricity at costs of 20 to 25 cents a kilowatt hour. Today, in the most outstanding sites, we are capable of generating electricity as low as 5 cents a kilowatt hour. At the more common wind sites, the more average wind sites, in California, it tends to be 7 to 9 cents a kilowatt hour, which means that it is not quite competitive with some fossil fuel technologies in the marketplace but nearing closer and closer with each year.

The California Energy Commission, in their evaluations of various technologies, has deemed wind to be competitive with other technologies, and when the total costs—environmental and other costs to society—are evaluated, have termed wind one of the cheapest alternatives.

Pacific Gas and Electric, which is the largest purchaser of wind energy in the country, has been doing their own evaluations of wind over the last few years. In a paper they released in January, they concluded that by early in the next decade wind will be the cheapest source of power available to them, and that could actually happen considerably faster than that, given what happens to fossil fuel prices.

So it has been tremendous progress in less than a decade, but we have actually taken some important and very disturbing steps backward over the last decade as well. Our competitors around the world are making rapid strides. We have six European countries that are investing more in wind R&D than the U.S. is today. The Netherlands is providing currently, along with the R&D, a 45 per-

cent subsidy to wind development. The Germans are providing 4.4 cents per kilowatt hour for wind development, recognizing the potential in the technology but the fact that to get the turbines into the marketplace in the near term is going to require additional support.

In the international markets, we are facing—our largest companies which are interested in exports—are facing very tough competition, particularly from the Danes. One example: In India, $24 million in tied aid was provided for a project in India, and, needless to say, U.S. Windpower did not get the project, the Danes did, and when our companies are overseas they don't carry those kinds of packages, and, believe me, it is tough to compete against.

What they recognize, our competitors, is that by the mid to late nineties wind energy will represent a multi-billion-dollar market. They are making the investments today to be able to reap the benefits of that market, and we sadly have not been.

We have abdicated what I think was once a clear cut technological leadership to our international competitors, and yet around the world interest in wind technology is at an all-time high, and with rising concern about the global environment it seems clear that wind technology has a promising future. The question is, will the U.S. have provided the foundation for strong participation by American industry in this growing market?

While I am pleased to say that when we look at a number of things happening today—the reorganization, the fiscal year 1991 budget request, and particularly the leadership demonstrated by Mike Davis—we begin to see the first glimmer in almost a decade that we have a chance to actually benefit in very substantial ways from the investment that this country made in wind technology over the last decade.

Now that is not because of the fiscal year 1991 wind budget request. I think the $8.6 million that was requested by DOE is totally inadequate given the fact that the Western Europeans are spending over $100 million themselves on wind R&D. We are recommending between $11 and $12 million for fiscal year 1991 and between $16 and $18 million for fiscal year 1992 for wind R&D. But the larger picture of the overall increased support for renewable energy and the more vigorous leadership within the Department, I think, is tremendously significant and sends a message about the place that renewable energy will have within our energy mix, and we are very pleased with that.

Wind was not identified as one of the new initiatives by DOE, but I have to be candid and say that I can understand some of that. Wind has been somewhat of a black sheep within the renewable energy technologies because of the technical failures in the early eighties, because of the failure of some of the Federal demonstration programs. I can understand that. The fact that that has changed and not all the decision-makers are necessarily totally aware of how the technology has evolved doesn't mean that we are not going to get the chance to be a full part of the new DOE renewable energy program. I am convinced that we will and that Mike Davis has certainly made that clear, and we are making progress in realizing the technology goals that were set out last year in Public Law 101-218 both in terms of capacity factor and in cost.

As far as the budget, let me mention two different examples of constrained resources that I think are telling in this regard. When I was out in California, I saw an example of cooperation between the Federal Government and industry that was quite impressive. The SERI testing of the new blade that promises 20 to 30 percent increases in energy productivity is a very impressive project and a good example of what can be accomplished.

Regrettably, I have to say that there are two new turbines, American turbines, in design, U.S. Windpower's and the Carter wind turbine, both of which have requested an opportunity for joint testing with SERI of their new equipment, and we are not sure how long it is going to be before that is going to be possible given the constrained resources. So that is an example of an area where we could definitely see some increased investment.

As far as the reorganization, let me say that I am not particularly concerned about the boxes on the chart that we saw. I think there are a lot of different ways that the agency can accomplish its mission. I think that what has been done has been well thought through and has accomplished—will accomplish a great deal.

I think that what is really important is the fact that the agency, which was so demoralized through the eighties, had the need for a new mission that was clearly defined and provided a new set of marching orders to the agency. That has been accomplished, and I think it is masterful the way the reorganization has done that. It created a certain amount of chaos within the agency; there was certainly a great deal of concern by a lot of people about who would be where, who would have what responsibility; I think all of that distraction was absolutely worth it, and, as I said, I think the reorganization is a masterful example of setting new marching orders, defining a new mission, and the mission of going beyond the emphasis on long-term R&D is absolutely essential towards working more closely on near-term cooperation with industry.

What we are facing now is a new attitude, the beginning of a new decade that holds, I think, fantastic promise for renewable energy, but reorganization is not enough, and even though R&D is terribly essential to the future—wind and other technologies—R&D, in and of itself, is not enough either. It will play a very significant role in lowering the cost of electricity from wind and other technologies, but it will not, in the end, bring these technologies into the marketplace as quickly as certain policy decisions that this Congress hopefully will be facing over the next few years.

Let me briefly mention a few of those items that I think could potentially be included within a new Lloyd-Sharp-Fowler initiative. Number one, production incentives for clean renewable energy, very significant; two, low-cost sources of capital. Renewable energy technologies are capital intensive. The fuel is free for the most part, so what we are facing is the up-front capital costs, and if those costs could be lowered that would make a significant difference. Three, competitive bidding systems now being developed on the State level should incorporate the social costs of conventional energy production and should also incorporate renewable energy set-asides to ensure that least-cost utility planning doesn't result in utility supply decisions that exclude renewable energy from a substantial role. Fourth, Federally sponsored information is essential

to overcoming the information gap, the understanding gap, that many still have about the potential role of renewable energy. Five, transmission access to major renewable energy resource areas is very significant. Six, CORECT has done a masterful job but with very limited resources. It is clear to us that the funding for CORECT should be dramatically expanded. Seven, R&D for renewable energy storage technologies should be expanded substantially. And, eight—and perhaps this is the most exciting concept of all which this committee played such a key role in bringing forward—the concept of public/private joint ventures.

We have been very pleased with the way that DOE has responded to the concept of joint ventures, the discussions about perhaps even expanding the concept of joint ventures in a dramatic way. We would certainly welcome that and view the potential of such a partnership between public and private could play a pivotal role in helping to make projects financially viable that are now deemed economically marginal compared to the subsidized costs of conventional fuels.

In summary, it is clear that the reorganization, the increased attention being given to renewable energy in the budget, and the new leadership at DOE really open up the door to a very exciting era. It is a time of immense opportunity for conservation and renewable energy. The challenge will be for all of us to ensure that we take maximum advantage of that opportunity, and I look forward to working with you as we try to do that.

[The prepared statement of Mr. Swisher follows:]

American Wind Energy Association

Board of Directors

President
Stanford H. Taylor
AeroVironment, Inc.

President-Elect
Dale W. Osborn
U.S. Windpower

Secretary
Randall Swisher
AWEA

Treasurer
Walter L. Sass
Second Wind Inc.

Michael L.S. Bergey
Bergey Windpower

James Dehlsen
Zond Systems

Harry Halloran
Energy Unlimited Inc.

Edwin T.C. Ing
Attorney

Robert Lynette
R. Lynette and Associates, Inc.

Donald Marier
Alternative Sources of Energy, Inc.

Robert H. Monroe
Cougeon Brothers, Inc.

Robert W. Sherwin, Jr.
Atlantic Orient Corp.

A. Norman Tetreh
Green Mountain Power Corp.

Lawrence E. VanBibber
Westinghouse Electric Corp.

Carl Weinberg
Pacific Gas & Electric

Environmental Policy Advisor
Christopher Flavin
Worldwatch Institute

STATEMENT OF
RANDALL SWISHER
EXECUTIVE DIRECTOR
AMERICAN WIND ENERGY ASSOCIATION
BEFORE THE SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

JUNE 6, 1990

Madame Chairman and members of the Subcommittee, my name is Randall Swisher, and I am Executive Director of the American Wind Energy Association, the national trade association for the wind energy industry since 1974.

I am pleased to have the opportunity to appear before the Committee today to share the wind industry's perspective on the subject of today's hearing: the Department of Energy's Conservation and Renewable Energy Programs.

OVERVIEW: CURRENT STATUS OF WIND ENERGY TECHNOLOGY

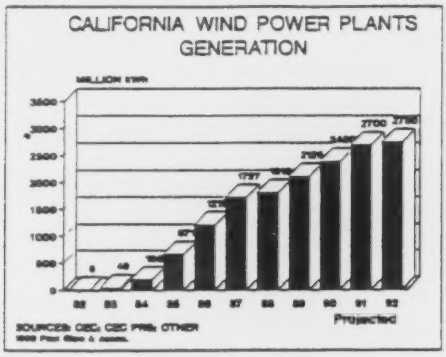
Clean, renewable energy technologies such as wind-generated electricity will play an essential role in making possible a growing and yet environmentally sustainable national and world economy. By the middle of the next century, the world's economy is expected to at least quintuple. Given the rising level of concern about fossil fuel emissions and the global environment, we can not expect to support dramatically increased economic activity based on fossil fuels. We must make a transition to clean, renewable sources of energy, and wind energy will play an important role in that transition.

The potential for wind energy technology is staggering. A variety of sources (including Lockheed, General Electric and the Energy Research Advisory Board) have conservatively estimated the technical potential of wind in the United States at one trillion kWh annually, or about 40% of today's electric demand. With utility-scale wind resources available in 37 of the 50 states, a national goal of producing 10% of our electricity using wind energy technology is realistic and attainable over the next few decades.

1730 N. Lynn Street, Suite 610, Arlington, VA 22209 USA Tel. (703) 276-8334 Telex 6503304640 MCI UW

Wind energy technology has made remarkable progress over the last decade. In 1981, the industry was virtually non-existent as a source of utility power, producing only 10,000 kilowatt-hours (kWh), or about enough to serve two homes. In 1989 in California wind generated 2.125 billion kWh, enough to serve the residential needs of a city of over 900,000 people--more than the city of Washington, D.C.

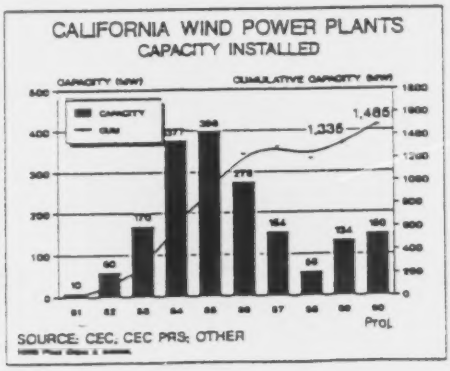
Figure 1



There are now about 15,000 wind turbines in California and Hawaii, providing a total installed capacity to electric utilities of approximately 1,400 Megawatts (MW).

As Figure 2 illustrates, wind energy experienced a "roller coaster" pattern of development in the 1980s. Spectacular growth in the early 80s in California was followed by a rapid decline when the tax credits expired in 1985 (federal) and 1986 (state). Development continues as lucrative state Standard Offer 4 (SO4) contracts are built out, but at a level that is less than 40% of what it had been at the peak.

Figure 2



Over the last decade, wind energy technology has made enormous strides through improved performance and decreased costs. In the first few years of commercial development, technical failure was common. In 1981, for example, the first utility-connected wind turbines were only functioning about 60% of the time. Today, turbines that have been introduced in the last five years generally have availability factors of over 95%.

Wind turbine capacity factors have also steadily increased, rising from an average of 13% in 1985, to almost 25% for new turbines in 1989, to over 40% for the best performing projects. This increased performance contributed to the 17% growth in wind-generated electricity last year in California.

The costs of wind-generated electricity have declined from 25 cents per kWh in 1981 to as low as 5 cents per kWh at the most outstanding sites or 7 to 9 cents at more typical wind sites. The goal of the federal wind research program is to achieve a 5 cent per kWh target at typical wind sites sometime between 1995 and 2000. This would make wind competitive with conventional technologies such as coal or even gas-fired electricity even without receiving an environmental "adder" for producing pollution-free electricity.

IMPORTANCE ~~OF INCENTIVES~~ FOR RENEWABLE ENERGY DEVELOPMENT

Renewable energy today provides about 9% of America's energy mix. Development of renewable technologies <u>will</u> continue, but policy decisions (see below) will dictate how quickly we realize the potential for renewable energy, as well as to what extent this emerging growth industry is dominated by American, Japanese, or European competitors.

As has been demonstrated by the California Energy Commission, wind energy is competitive today with conventional fuels when one evaluates the total costs of electricity generation. There are many costs that are not reflected in our utility bills that consumers must pay one way or another--the environmental impacts, the health effects from spewing millions of tons of pollutants into the air we breath, substantial tax and research and development subsidies, and depletion of nonrenewable resources.

These billions of dollars of costs make a seemingly cheap source of energy relatively expensive for society. Such "social costs" represent a huge subsidy to conventional sources of at least three to six cents per kWh, according to German economist Olav Hohmeyer, and put clean renewable technologies such as wind at a systematic disadvantage.

A similar study by the California Energy Commission, entitled "The Social Costs and Benefits of Electricity Generation and End-Use Technologies," reached conclusions that closely parallelled Hohmeyer's, and found wind to be one of the least expensive electric technologies when social costs are considered.

After taking an impressive lead in development of renewable technologies in the late 70s and early 80s, the U.S. has steadily disinvested in these emerging technologies. At the same time, Western Europe and Japan are making major strides toward renewable energy development.

Six European countries are each currently investing more than the U.S. FY 1990 total of $9.127 million annually in wind research and development. West Germany has recently established a subsidy of 4.4 cents per kWh for wind projects, and the Netherlands is providing a 45% subsidy for private wind developers, with a maximum subsidy amount of $2.65 million per project.

In the international markets, Danish companies (with substantial governmental support) have proven to be fierce competitors of American wind manufacturers. For example, Denmark won a contract for a wind development in India by providing $24 million in tied aid for the project. The Europeans have used subsidies first of all to nurture new wind companies using market incentives to build a domestic wind industry. Secondly, they have subsidized their international competitiveness to establish a strong presence in foreign markets. Both types of support are based on the knowledge that by the mid to late 90s wind energy will represent a multi-billion dollar business with major export potential. Even today wind energy technology represents Denmark's seventh leading export.

In an American energy economy where conventional fuels are heavily subsidized and wind technology is not, the outlook ought to be obvious: the potential for wind energy technology may be realized, but only over a much longer period of time than is consistent with our national interest. It is also clear that the huge markets for wind technology, both nationally and internationally, are most likely to be taken advantage of by those countries that have had the foresight to nurture this fledgling industry in the late 80s and early 90s.

Right now the U.S. is failing the test. We have removed the tax credit for wind technology and watched the industry go into a tailspin. The U.S. has cut federal wind research and development to 10% of what it was a decade ago. We have abdicated what was once clear cut technological leadership to our international competitors. And yet, around the world, interest in wind technology is at an all-time high, and with rising concern about the global environment it seems clear that wind technology has a promising future. The question is: will the U.S. have provided the foundation for strong participation by American industry in this growing market?

FISCAL YEAR 1991 BUDGET REQUEST

The Department of Energy's FY 1991 budget request represented a significant change over the previous decade, with an actual increase in renewable energy budgets and a number of new renewable energy initiatives. The overall message was that renewable energy is serious technology with significant potential and should receive more thoughtful treatment from federal policymakers. We applaud that message as long overdue, and salute Assistant Secretary J. Michael Davis for demonstrating the ability to reverse a shameful decade of neglect of renewable energy technology.

The specific budget request for wind energy was only $8.6 million, an actual reduction from FY 90. With Western European nations spending approximately $100 million annually on wind R&D, DOE's proposed budget is clearly inadequate to run a competitive program. The American wind industry, with 80% of the world's wind capacity, has built a tremendous foundation to take advantage of the growing world interest in wind technology, but the DOE budget proposal is totally inadequate to achieve that. Fortunately, Congress appears likely to support a higher budget level for wind energy programs.

DEPARTMENT OF ENERGY REORGANIZATION

It is far too early to reach any conclusions about the effectiveness of the reorganization of DOE's Conservation and Renewable Energy Programs, but AWEA believes that the reorganization is heading in the right direction. Reorganization by end-use makes sense, but far more important has been the move away from the almost total emphasis upon long-term research and development.

Sadly, the wind industry has achieved what it has in the 1980s with minimal involvement or support from the Department of Energy. The partnership between DOE and industry has been extremely limited, even in the R&D area. The emphasis upon long-term R&D that prevailed within DOE over the last decade undermined any real potential for near-term public/private cooperation. Commercialization was treated like a dirty word, and yet relying solely upon "market forces" to commercialize infant industries like wind and solar would put off their reaching market potential for decades.

There is now a different attitude prevailing at the Department of Energy. It is a more informed attitude, reflecting a greater understanding of the process of technology development. Out of that has flowed a more cooperative attitude toward industry, toward development of real partnerships between the public and private sectors. It could be the beginning of a decade of enormous promise for renewable energy and American energy security. There are a number of steps that Congress could take, in cooperation with DOE and industry, that could help ensure that such promise is realized.

First of all, R&D is important, and the federal wind R&D program could play a significant role in helping to lower wind energy costs of electricity through projects such as the Advanced Wind Turbine. But the greater need today for wind and other renewable technologies is for breaking more rapidly into the markets and for overcoming regulatory and other institutional barriers to renewable energy development. What are the policies Congress should be considering to achieve such development?

1) Production incentives of 4 cents per kWh for clean renewable technologies such as wind and solar;

2) Low-cost sources of capital for renewable energy technologies;

3) Competitive bidding systems now being developed on the state level should incorporate the social costs of conventional energy production and there should be renewable energy "set asides" for at least 10% of all new generating capacity where an adequate resource base for cost-

effective renewable technologies exists (wind, solar thermal, geothermal, biomass or small hydro);

4) Federally-sponsored information or technology transfer campaigns to help close the information gap that is still facing wind and other renewable technologies;

5) Transmission access to major renewable energy resource areas;

6) The Committee on Renewable Energy, Commerce and Trade (CORECT), which has been a remarkable success with limited funding, should be dramatically expanded;

7) R&D for renewable energy storage technologies should be expanded to help "intermittent" renewable technologies such as wind and solar realize their full potential; and

8) AWEA is quite enthusiastic about DOE's interest in public/private joint ventures as a way of bringing renewable energy more quickly into the mainstream utility market. This concept, which is based on this Committee's work in the "Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989," should be greatly expanded over the next few years as one of the most promising means to more widely introduce renewable technologies. Despite the success of wind technology in California, Denmark and Hawaii, many people continue to be uninformed about the cost, reliability and performance record of the modern wind industry. More widespread project development is essential to overcoming such attitudes, and federal partnership can play a pivotal role in helping to make projects financially viable that are now deemed (compared to the subsidized costs of conventional fuels) economically marginal.

As was mentioned earlier, it is too soon to make a final judgment about the effectiveness of the DOE reorganization, but AWEA believes that the current direction of the reorganization is to be applauded and supported.

Mrs. LLOYD. Thank you very much.

Mr. Morrison.

Mr. MORRISON. Thank you.

I am pleased with your testimony, and, of course, I think the entire hearing has pointed out a general pleasure with the restructuring and the emphasis in line with some things that came from this very subcommittee, so we are pleased with that.

Dr. Stokes, it is good to see you again even with a different hat on. That is a tribute to you.

Solar detox was picked at just a little bit by an earlier witness, and yet I think both Mrs. Lloyd and I have seen that as an exciting potential, and, that is, the emphasis for this has come from SERI during the years that I have been involved. Can you give us an update on that just to renew our faith in the process?

Dr. STOKES. Certainly, Congressman.

As you know, the Department of Energy has one of the most daunting problems with waste disposal, even the purely hazardous chemical waste disposal, within the entire United States. So a good deal of the emphasis and early impetus in funding for the effort came from the need to work with the environmental restoration and waste management side of DOE, looking at all possible technologies, and it turns out that the very short wavelength range of solar radiation in concentrated form is extremely effective at catalyzing the chemical destruction of many of the hazardous chemicals—TCE, PCB's, things of this sort—and, perhaps more importantly, the technology permits us to take these original chemicals not to by-products that are possibly almost as hazardous as what we start with but to rather innocuous salts and hydrochloric acid, and we have recently been discussing even with the staff at Hanford about the possibility for the first time of applying the technology to mixed chemical/radioactive wastes, and it appears there are some very interesting possibilities.

We at SERI, of course, are not experts on radioactive decontamination. However, the people at Hanford are, and they claim that if we can, through the solar technology, eliminate the chemical component, then dealing with the radioactive residue is actually very straightforward and consistent with the problems.

So we are working now not only with Hanford but with Livermore and Oak Ridge to look at some demonstration projects within the DOE system. We believe that this is the necessary precursor to developing the private industry, the industry, and we are beginning to work with the Environmental Protection Agency.

One of the biggest drivers for eventually transferring this technology to the private sector is the need to treat hazardous wastes on site, in situ, so to speak. The solar technology is very modular, can be handled without the necessary permitting to move the hazardous waste along U.S. highways.

So, again, we are looking with the private sector, but our primary focus at the moment is within the DOE system because we think it is the most expedient, the quickest route to getting all of us, including the Solar Energy Industries Association, to where it needs to go.

Mr. MORRISON. So any criticism at this point for lack of a private enterprise partner is perhaps a little premature.

Dr. STOKES. There are no commercial products currently being offered to the market. We see developing the market as the first step.

Mr. MORRISON. There's no question that the market is there, the demand certainly is.

Dr. Stokes, you also mentioned a 60 percent increase by the year 2030 in total energy needs. Did that—Does that number include conservation, or a best guess at conservation, or how should we view that? That's a little higher than any I have come across.

Dr. STOKES. That's the official National Energy Strategy baseline projection. It does include some significant gains in conservation. It also makes some assumptions related to the connection between energy growth and growth in GNP which are, I think, fairly optimistic.

We, all of us, I think, within the conservation and renewable energy community would like to see that number much lower than what the projection shows, and we are very hopeful that we won't be needing 130 quads of energy in 2030. But many of the problems that we're looking at are quite daunting and—but I think that's about the level of significance of that number.

Mr. MORRISON. Dr. Klass indicates that maybe as much as half of that can come from biofuels.

Dr. KLASS. Oh, without any doubt. I would say at least half. Some of our own projections indicate that the potential for up around 50 quads is actually there for biomass as well as waste materials to energy. So we would hope that by the year 2030 a significant increase occurs over where we are now, which is sizeable, by the way. It's about three quad today from biomass per year.

Dr. STOKES. Yeah, we would certainly agree with that assessment. We think that both in the transportation sector and the electricity sector, biomass has the potential for—our estimates are running around 20 quads or so, but that is a substantial increase over what is current.

Mr. MORRISON. SERI is involved in this process.

Dr. KLASS. Sir, it is most definitely involved in biofuels R&D.

Mr. MORRISON. And your view of that, in light of the reorganization, is positive; we're going to call it something else so we get some—America beginning to pay some attention to it.

Dr. KLASS. Well, I think certainly the reorganization has drawn attention to conservation and renewable energy activities in the R&D area.

Mr. MORRISON. I was referring specifically to the transportation fuels. Of course, I like your biofuels terms, very frankly.

Dr. KLASS. Bio—A lot of people have trouble with the term "biomass" itself. I think, just for the record, once and for all, we ought to all agree on what the definition of biomass is. It's all growing and dead organic matter, as well as all waste materials of an organic nature. That includes municipal solid waste as well as municipal sludge, trees, and every other kind of fixed carbon that's organic in nature. So——

Mr. MORRISON. Your testimony mentioned moving away from the aquatic materials.

Dr. KLASS. Yes. We recommended that that work be minimized, with a limited budget that currently exists, and which would also

be limited, I think, for fiscal '91, and that the emphasis be given to terrestrial biomass production, primarily trees, and herbaceous materials such as grasses. We feel that the potential is much higher there in the short to medium term than it would be for aquatics at the moment.

Aquatics research would be long term research. We are not suggesting that this be totally terminated but that it be minimized and the other categories that I mentioned be maximized.

Mr. MORRISON. Mr. Swisher, I'm delighted with your optimism. Some of us that kind of watched some of the turbine development, I guess, as you indicated, all of that, while it didn't result in immediate products, gave us a base on which to build a positive future.

What size turbine seems to be working out? That's one of the wrestling matches we went through over a number of years. Big ones in my district, which my predecessor took great pride in, have been sold for something less than generating capacity.

Mr. SWISHER. Well, the big machines that were so much the emphasis early in the program just aren't in the picture as far as we can tell at this point. I think the optimum size that we will see for utility generation by the next five to ten years will be in the range of about 500 kilowatts, and that what we have--U.S. Wind Power's new machine, for example, is a 300 kilowatt model. A number of other American manufacturers are considering turbines up to 500, maybe 600 kilowatts. I don't expect that it would get substantially beyond that.

Mr. MORRISON. And this new blade breakthrough, is that technology that we haven't seen at all?

Mr. SWISHER. It's technology that you can see near Palm Springs that is being demonstrated by SERI, in cooperation with a number of American operators, but it's not yet available on the market.

The thing that's quite interesting about it is that it is a blade, American designed and manufactured, that is made to retrofit Danish machines. And so we're going to be able to hopefully take advantage of an opportunity for American manufacturers to actually recoup some of what our foreign competitors introduced into this country.

Mr. MORRISON. That's exciting and pleasing. Thank you very much.

Mrs. LLOYD. I want to thank you gentlemen. Our time has so gotten away from us, and I'll be submitting questions to you in writing, if you'll respond, and they'll be made a part of the record.

The hearing—I think it's been an excellent hearing, very upbeat. It seems to me that we're going in the right direction and we certainly are proud of all that you and your organizations are doing to contribute to our energy mix. I think the future for your technologies is very bright and we want to be a part of it.

If there is no further discussion, the Subcommittee stands adjourned.

[Whereupon, at 4:44 p.m., the Subcommittee was adjourned.]

APPENDIX I

[redacted]
Center for
Electrochemical Systems and Hydrogen Research

[redacted]

238 Wisenbaker Engineering Research Center
Texas Engineering Experiment Station
The Texas A&M University System
College Station, Texas 77843-3577
(409) 845-8281

June 20, 1990

The Honorable Marilyn Lloyd
Chairwoman, Subcommittee on
Energy Research and Development
Committee on Science, Space and Technology
U.S. House of Representatives
B374 Rayburn House Office Building
Washington, DC 20515

Dear Ms. Lloyd,

We appreciate the opportunity to submit testimony for the record regarding the hearing on June 6, 1990 in the subcommittee on Energy Research and Development.

The Conservation and Renewables Program is at a crossroads with so much emphasis on the environment this past year, and the anticipated attention in the coming decade. We applaud your leadership and the leadership of your colleagues in determining how the Department of Energy's reorganization and the passage of PL#101-218 will impact the individual programs within the Conservation and Renewables Section of the budget.

On behalf of the Renewable Hydrogen Consortium, again thank you for the opportunity to express our views.

Sincerely,

A. John Appleby

Dr. A. John Appleby
Director,
The Center for Electrochemical
Systems and Hydrogen Research

Encl.

TELEFAX 4098459287 • TELEX 5108927689 TXCM COSN

The Renewable Hydrogen Consortium
Statements for the Record
of the
Committee on Science, Space and Technology
Subcommittee on Energy Research and Development
U.S. House of Representatives
June 6, 1990

The Renewable Hydrogen Consortium consists of the following entities: The Hawaii Natural Energy Institute, The Florida Solar Energy Center, The Center for Electrochemical Systems and Hydrogen Research of the Texas A&M University System, and the Clean Energy Research Institute of the University of Miami.

Following comparative neglect of long-term energy strategy since 1980 several energy-related concepts are beginning to dawn upon the national conciousness. These considerations can have significant implications for national growth and security during the next decade and beyond. They are:

- The nation's economy is inextricably tied to energy costs and availability
- Electricity demand is expanding, and capacity shortfalls are imminent or already exist in many regions
- Attempts to encourage transportation fuels other than those based upon oil products have been weak misdirected, and too variable to provide a long-term solution.
- Foreign control of oil resources threatens not the national economy, but also the national security.
- Environmental risks posed by fossil energy consumption and by the political and economic mishandling of nuclear power threaten both national and global welfare.

These concerns combine to form a complex series of problems which may become the most difficult that the nation has ever addressed. To fuel a growing economy, the nation requires energy end-use in the future.

The Department of Energy's Restructuring

Even though the role of hydrogen in Advanced Utility Concepts has yet to be fully defined, overall we are glad to see the Department's focus shift somewhat to an emphasis on end-use. The most efficient and economical end-use energy for most applications is electricity. Electricity produces no pollution at the point of use, and is easily directed and controlled, especially for state-of-technology applications. However, the large, central steam plants traditionally used for electricity production are capital intensive and, when employed with inexpensive fuels such as coal, are not environmentally benign. Only large steam or nuclear plants make sense from the engineering point of view, but these require so much time to build and license that utilities have been reluctant to add new capacity.

The further development of nuclear energy would certainly reduce chemical emissions and their atmospheric products, but unfortunate political, technical and economic decisions coupled with stifling regulations makes its contribution unlikely in the forseeable future. Thus, the ultimate solution to our energy problems must be an eventual shift to the use of renewable resources like hydrogen. We therefore agree with the placement of the hydrogen program in Advanced Utility Concepts.

However, another end-use application under consideration overseas is hydrogen's use in transportation. While the Department is still defining the applicability of the hydrogen program to their reorganization, we urge them not to neglect hydrogen's role in this vital area of our nation's energy consumption.

While electricity is desirable for stationary applications, it is difficult to store for use in transportation, even though its use for this purpose would greatly reduce the problems of urban pollution. Transportation in the future is envisaged simply as an extrapolation of the past, using the same mechanical devices as those of today. Urban pollution will demand reduced tailpipe emissions, but the use of most fossil-based fuels will continue our dependence on foreign oil, and thus undermine our energy security. In the 1970's, the vehicle fuel of the future was expected to be methanol manufactured from domestic coal. While methanol fuel would reduce some urban emissions, its use would double carbon dioxide emissions compared to gasoline. It is now proposed that methanol be produced from inexpensive, imported foreign natural gas. This will exacerbate the problem for energy security.

Hydrogen is no ordinary fuel, because it can be converted into useful electricity by direct energy conversion (i.e., without hot combustion) in a fuel cell. All other fuels must be burned, leading to a 40% efficiency of conversion to work. Hydrogen conversion to electricity can, in contrast be as high as 65%. This unique property of hydrogen should be exploited because it can result in lower energy costs and dramatically reduced pollution. Efficiency is only one of many attractive features of fuel cells. Insignificant pollution, modularity, siting flexibility, compactness, load following capability, short construction time and an extremely broad range of application potentials make fuel cells a power generation technology unmatched by any other. Thus, dedicated hydrogen fuel cells offer a clean, efficient alternative means of generating electric power, as

well as a practical alternative for electric vehicle propulsion. However, the technology for using hydrogen fuel cells is not available today as engineered units, although component development work has been conducted.

As an example, a hydrogen fuel-cell electric motor could have three times the efficiency of a spark-ignition engine and twice the efficiency of a diesel engine in urban use. Such vehicle fuel cells can virtually eliminate urban air pollution currently caused by gasoline-driven cars. In spite of these facts, only a limited R&D effort has so far been made in this area.

We need an emphasis on the further development of renewable energy for use in electrical **and** transportation alternatives.

We have previously testified on the importance of developing hydrogen fuels from renewable energy resources. Madame Chairman, your subcommittee and the Congress have consistently supported the concepts of the program of the Renwable Hydrogen Consortium. The University Institute members of the Consortium, under the management of the Solar Energy Research Institute, have undertaken the National Hydrogen Research Program using the amounts authorized by this subcommittee from FY88 to FY90, totalling $2.4 million annually.

We emphasize that this is the entire R&D effort at the Department of Energy on the use of hydrogen as a storable means of transporting clean energy from one place to another, allowing maximum conversion efficiency for both its production and end-use. The DOE can claim that it is spending over ten times this figure on hydrogen R&D, but the majority of these funds relate to studies of hydrogen properties and handling under the special conditions of the nuclear industry and for nuclear fusion. This bears no relation to the use of hydrogen as an alternative energy carrier to meet our long-term needs for on-site and transportation power.

The Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989.

The Renewable Hydrogen Consortium applauds the leadership of you, Madame Chairman, and other members of the Committee, especially Mr. Walker, for the interest shown in including hydrogen in PL 101-218.

It is clear to everyone concerned with the topic of renewable energy that these promising technologies need assistance to become competitive in the marketplace. Hydrogen is no exception. In the short term, hydrogen can act as an energy supplement to our traditional energy supply. In the final analysis, only hydrogen produced from renewable resources can meet long-term concerns. By producing the hydrogen fuel from renewable resources, we can ensure that its production does not create as many problems as it solves. Hydrogen from renewables has no significant global warming implications. The renewables may be solar radiation or some indirect form of solar energy such as wind or biomass. Solar radiation and wind can produce electricity, which can be used on site where possible. The electricity must, however, be stored for use throughout all hours of the year. The ideal storage medium for this electricity is hydrogen because it can be converted back to electricity at high efficiency using fuel cells. Hydrogen can upgrade biomass to

manufacture traditional fuels, or it can be made by the gasification of biomass. While biomass transformations involve carbon dioxide, this is recycled in the atmosphere without accumulation.

While the Renewable Hydrogen Consortium has made great progress during its three years of existence, other nations, particularly Japan and West Germany, are fast outpacing U.S. research on and development of the hydrogen energy alternative. Last year, Japan committed to hydrogen R&D, more than 10 times as much funding as the United States. Germany spent $50 million for hydrogen research in 1988-1989. Companies such as Daimlar-Benz and BMW, are already proposing hydrogen fuel applications such as hydrogen-powered cars. In addition, the German government is supporting the world's largest renewable hydrogen project, which proposes to produce hydrogen in Canada from hydropower, and ultimately from photovoltaic electricity in North Africa. It is proposed that the hydrogen be shipped to Europe as liquid using tankers or pipelines. The first application will be in city buses, for which the German automobile manufacturers are developing auxiliaries, such as pumps, and infrastructure. The United States has developed similar technology for the specialized needs of the Space Program, but none of this technology has been reduced to terrestrial practice and therefore not considered for competition in a global marketplace.

Hydrogen competition comes from unexpected quarters. Last fall, at the 7th World Hydrogen Energy Congress in Moscow, those in attendance witnessed two surprises. The first occurred when the USSR keynote speaker addressed the greenhouse effect and the huge potential of hydrogen to ameliorate its damage to our world. In fact, the hydrogen solution to global warming was the chief subject of discussion among more than 700 scientists in attendance from all over the world. The second surprise was the presentation of a film showing Aleksei A. Tupolev's historic flight of a modified Soviet TU-155 commercial jet (equivalent to a Boeing 727) powered by liquid hydrogen. Technological competition in hydrogen research comes from the Soviet Union despite their economic downturn.

This is why PL 101-218 is an important law for hydrogen. Even though hydrogen has been involved in some of the largest fuel demonstration programs in our nation's history, its demonstration and application has been limited to its uniqueness as the space fuel. However, the Renewable Energy and Energy Efficiency Technology Competitveness Act of 1989, has placed hydrogen in the realm of commercial terrestrial development. This Act has accomplished what the American marketplace has not, but what other countries see as an opportunity not to be missed. Hydrogen's transition is overdue, but no less welcomed.

In Closing

Hydrogen from renewables offer solutions to the possible greenhouse effect, because of the potential for significant savings on carbon dioxide emissions in both transportation and power generation sectors. In addition, these technologies can help to reduce the nation's trade deficit, the largest portion of which is caused by importation of foreign oil, as well as increase national security. The work conducted by the Renewable Hydrogen Consortium is critical in

that it lays the groundwork for future hydrogen R&D, application, commercialization and some of the issues being discussed here today. As is realized by our foreign competitors, enhanced R&D for hydrogen production from renewables is a necessity if we are to make the transition from globally polluting to benign power sources.

The Nation and the Department of Energy are poised on the brink of significant advances in hydrogen R&D. We wish to send a clear message that we, as representatives of the academic community, support the Congressional leadership in advocating continued hydrogen R&D and demonstrations through the passage of PL 101-218. To the Department of Energy we urge their continued support of hydrogen production from renewables, but are glad for the emphasis of end-use in the Conservation and Renewables Program. We would suggest that as the hydrogen program becomes more defined within the Department that in addition to hydrogen's obvious fit with utilities, that its fit with transportation not be ignored.

PMAA
PETROLEUM MARKETERS ASSOCIATION OF AMERICA
1120 VERMONT AVE., NW • SUITE 1130 • WASHINGTON, DC 20005 • (202) 331-1190

June 5, 1990

The Honorable Marilyn Lloyd, Chairman
Subcommittee on Energy Research & Development
Committee on Science, Space, and Technology
House of Representatives
Washington, DC 20515

Dear Madam Chairman:

The Petroleum Marketers Association of America (PMAA) is a national organization of 43 state and regional trade associations representing the nation's independent heating oil and motor fuel marketers. PMAA's member associations are comprised of some 11,000 independent marketers of petroleum products, including thousands of retail fuel oil dealers, who account for nearly 75% of the home heating oil and 50% of the gasoline sold in the United States each year.

PMAA would appreciate your subcommittee's consideration and inclusion of the enclosed statement in the official record of the June 6 hearing on the FY91 budget request for the Department of Energy's Conservation and Renewable Energy Programs.

Please feel free to have your staff contact either me or Amy Graham, PMAA's Heating Fuels Counsel, if we can be of any assistance. PMAA and its members greatly appreciate your cooperation on this issue.

Sincerely,

Al Cobb
Vice President for Legislative
and Political Affairs

AC/vs
Enc.
cc: Sid Morrison, Ranking Member of the Subcommittee

PETROLEUM MARKETERS ASSOCIATION OF AMERICA
1120 VERMONT AVE., NW • SUITE 1130 • WASHINGTON, DC 20005 • (202) 331-1198

April 24, 1990

The Honorable Marilyn Lloyd, Chairwoman
Subcommittee on Energy Research & Development
Committee on Science, Space, and Technology
House of Representatives
Washington, DC 20515

FILE COPY

Dear Madam Chairman:

The Petroleum Marketers Association of America (PMAA) is a national organization of 43 state and regional trade associations representing the nation's independent heating oil and motor fuel marketers. PMAA's member associations are comprised of some 11,000 independent marketers of petroleum products, including thousands of retail fuel oil dealers, who account for nearly 75% of the home heating oil and 50% of the gasoline sold in the United States each year.

PMAA would appreciate your subcommittee's consideration of the enclosed statement when deliberating the Department of Energy's Conservation Research & Development Budget for FY91.

Please feel free to have your staff contact either me or Al Cobb, PMAA's Vice President for Legislative and Political Affairs, if we can be of any assistance. PMAA and its members greatly appreciate your cooperation on this issue.

Sincerely,

Amy Graham

Amy Graham
Heating Fuels Counsel

AG/vs
Enc.
cc: Members of the Subcommittee

Statement
Advocating a
DOE Conservation Research and Development Program for Home Heating Oil

The Petroleum Marketers Association of America (PMAA), is a national federation of 43 state and regional trade associations representing almost 11,000 independent marketers of petroleum products, equipment and service across the country. While eighty-nine percent of PMAA's members are classified as small businesses by the Small Business Administration (SBA), collectively we sell over three quarters of the home heating oil and half the gasoline in the United States.

This statement will cover five points:

- o Identify the R&D funding element within DOE's budget;
- o Discuss the R&D benefits to consumers;
- o Describe the R&D program, with a summary in the text and details attached;
- o Explain the role of the federal government;
- o Discuss the budget limitations and why the oil heat program is justified.

Funding Element

For FY90, Congress allocated $1,000,000 of DOE's conservation budget to continue the combustion research program on oil heat equipment. The combustion program is an element of a key activity called Technology and Consumer Products, within the Buildings and Community Systems Division, which reports to the Assistant Secretary for Conservation and Renewable Energy. In this statement, PMAA advocates continuing the program for FY91, at an increased funding level.

R&D Benefits for Consumers

Federal oil heat R&D research has been very beneficial to consumers of oil heat by providing greater options for conservation, and has benefited the nation as a whole by reducing pollutant emissions. The oil heat program that was started in 1976 at Brookhaven National Laboratory is one of the most successful stories in federal research history.

With an R&D investment of less than $10 million, Brookhaven has demonstrated, among other things, the success of the flame retention burner that has become the industry standard for new oil heating equipment. New flame retention equipment and retrofit devices for existing oil burning equipment have been estimated to save consumers over 10 billion dollars through reduced oil usage by the end of the next decade. This amounts to one of the best benefit/cost ratios ever funded by DOE.

Additional improvements that have resulted from development or demonstration activities at Brookhaven include typical energy savings of 9-10 percent for vent dampers and flue heat recovery systems used with hydronic oil boilers. Cumulative energy savings for improvements to high efficiency burners and boilers are expected to exceed another $7 billion by the year 2000.

For FY90, DOE is proceeding with a very modest research effort in five promising areas of activity: performance control studies, fuel oil atomization/combustion studies, direct venting technology development, fuel quality studies, and technology transfer activities.

Proposed R&D Program

PMAA strongly supports continuing the current research effort and believes that there are several additional projects that should be undertaken by DOE in FY91 that are equally as promising in terms of costs and benefits as the example of the flame retention burner. These projects have been identified and are described in detail in a study by Battelle Pacific Northwest Laboratory. A copy of the Battelle Study has been provided to the subcommittee staff. Briefly, a total funding level of $3.8 million is required in three areas of activity:

- First, $2.1 million for efficiency advances on equipment such as heat exchangers and venting systems.
- Second, $1.3 million for advanced combustion and control, including pulsed combustion oil heating equipment.
- Finally, $400,000 for technology transfer programs.

A description and proposed funding level for these projects are summarized on the fourth page of this statement. The estimated fuel savings for these programs was taken from the Battelle Pacific study appendix, Table A.1. Fuel savings estimates for the various program elements range between 5 percent and 32 percent. Estimated market penetration rates range from 5 to 50 percent.

Based on annual fuel oil consumption of one quadrillion BTU, these projects are expected to save consumers as much or more than the retention head burner is saving. Estimates of the cumulative savings over 20 years for each program element range from $779 million to $12.6 billion, as shown in the last column in the table. The total of all elements could save up to $39 billion.

Federal Role is Needed

Due to the non-monopoly operations of fuel oil marketers who compete freely with one another, a federal R&D role is needed for the oil heat industry, even more than for competing industries that benefit from strong federal participation in R&D. The federal R&D programs for other fuels augment the work of the Gas Research Institute and the Electric Power Research Institute, which are funded by hundreds of millions of dollars in surcharges on gas and electricity rates that are approved by federal and state regulatory authorities.

By contrast, local oil heat marketers have no exclusive sales territories and no government approval or means to impose R&D surcharges. Major oil companies, which produce and refine oil

products, do not accept responsibility for any R&D activities on behalf of equipment manufacturers or any end users, including space conditioning, automobiles or airplanes.

Most manufacturers of oil heat equipment also make gas and/or electric appliances. With a relatively smaller sales potential in oil, it is understandable that equipment manufacturers commit their limited resources to the gas and electric equipment that is the focus of the government and utility research efforts.

Therefore, it is up to the federal government to provide funding for oil heat R&D, in order to maximize conservation options to the 15 million U.S. homes dependent on oil. While PMAA does not subscribe to the view that energy supplies will dry up tomorrow, it would be wise to have a strong conservation program to reduce consumer energy demand. With an investment of only $3.8 million, the federal government can strongly encourage reduced consumer demand for home heating oil by taking advantage of exceptionally high benefit/cost ratios for oil heat R&D.

Budget Limitations

PMAA is aware of the Gramm-Rudman limitations on the budget, and supports efforts to lower the deficit through reductions in federal spending. PMAA is not asking for additional budget authority. PMAA believes that the budget proposal is more than adequate for DOE to meet the needs of its various constituent publics, including oil heat.

Out of its $17.5 billion budget request for FY91, DOE is requesting a budget of $1.7 billion for energy research and development to serve the American public. Since 18 percent of American homes use oil heat, it is only fair that their needs for increased conservation options be protected by the allocation of $3.8 million to be devoted exclusively to oil heat. After all, the federal government is devoting billions of dollars to competing sources of energy such as natural gas, electricity, nuclear, coal and exotic energy forms such as solar and renewables.

PMAA believes that if DOE is going to continue any R&D programs at all, then it is only fair to the 18 percent of American taxpayers who heat with oil that oil heat get its tiny slice of the R&D budget pie. PMAA strongly urges the support of this Subcommittee for a necessary portion of DOE's total budget to continue an oil heat program with such an excellent and beneficial track record.

Thank you for considering PMAA's statement on behalf of heating oil marketers and consumers.

4

R&D Program for Oil Heat Technology

The following projects are critical to oil heating equipment research and development for FY91 to improve conservation dramatically:

		Proposed Budget ($ Thousands)
A.	Equipment Efficiency Advances	$2,100
1.	Improved Venting Systems (Direct Vent Technology Development) (400)	
2.	Advanced Heat Exchangers (750)	
3.	Oil Burner Diagnostics (550)	
4.	Fuel Quality Variation and Combustion Efficiency (400)	
B.	Advance Concepts: Combustion, Modulation and Dynamic Controls	$1,300
5.	Fuel oil atomization research to improve fuel oil combustion technologies (340)	
6.	Advanced performance control strategies for oil-fired heating equipment (380)	
7.	Advanced combustion systems research, including pulsed oil heating equipment (250)	
8.	Systems integration/development (330)	
C.	Education/Technology Transfer	$ 400
9.	Conferences/Symposia/Workshops	
10.	Accelerate the use of energy conservation options by establishing a consumer-oriented information program	
11.	Production of special documentation and technical training aids	
TOTAL FY 1991 Budget		$3,800

APPENDIX II

ROBERT A. ROE, New Jersey, CHAIRMAN

GEORGE E. BROWN, Jr., California
JAMES H. SCHEUER, New York
MARILYN LLOYD, Tennessee
DOUG WALGREN, Pennsylvania
DAN GLICKMAN, Kansas
HAROLD L. VOLKMER, Missouri
HOWARD WOLPE, Michigan
BILL NELSON, Florida
RALPH M. HALL, Texas
DAVE McCURDY, Oklahoma
NORMAN Y. MINETA, California
TIM VALENTINE, North Carolina
ROBERT G. TORRICELLI, New Jersey
RICK BOUCHER, Virginia
TERRY L. BRUCE, Illinois
RICHARD H. STALLINGS, Idaho
JAMES A. TRAFICANT, Jr., Ohio
LEE H. HAMILTON, Indiana
HENRY J. NOWAK, New York
CARL C. PERKINS, Kentucky
TOM McMILLEN, Maryland
DAVID E. PRICE, North Carolina
DAVID R. NAGLE, Iowa
JIMMY HAYES, Louisiana
DAVID S. SKAGGS, Colorado
JERRY F. COSTELLO, Illinois
HARRY JOHNSTON, Florida
JOHN TANNER, Tennessee
GLEN BROWDER, Alabama

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-6371

ROBERT S. WALKER, Pennsylvania
F. JAMES SENSENBRENNER, Jr., Wisconsin
CLAUDINE SCHNEIDER, Rhode Island
SHERWOOD L. BOEHLERT, New York
TOM LEWIS, Florida
DON RITTER, Pennsylvania
BOB MORRISON, Washington
RON PACKARD, California
PAUL B. HENRY, Michigan
HARRIS W. FAWELL, Illinois
D. FRENCH SLAUGHTER, Jr., Virginia
LAMAR SMITH, Texas
JACK BUECHNER, Missouri
CONSTANCE A. MORELLA, Maryland
CHRISTOPHER SHAYS, Connecticut
DANA ROHRABACHER, California
STEVEN H. SCHIFF, New Mexico
TOM CAMPBELL, California
JOHN J. RHODES, III, Arizona

ROBERT C. KETCHAM
Chief of Staff
JOHN S. DOYLE, Jr.
Chief Counsel
DAVID O. CLEMENT
Republican Chief of Staff

June 7, 1990

The Honorable J. Michael Davis
Assistant Secretary for Conservation
and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

Dear Mr. Davis:

Thank you for your excellent testimony at our Subcommittee hearing on the Department of Energy's Renewable Energy and Energy Conservation Research and Development Programs on June 6, 1990.

We would like to supplement the record of the hearing with your responses to the attached questions. We would appreciate receiving your responses within three weeks from the date of this letter. Please forward this information to the Subcommittee office, B-374 Rayburn House Office Building, Washington, D.C. 20515, to the attention of Cheryl Faunce. A copy of the hearing record will be forwarded to you as soon as it becomes available.

I appreciate your cooperation in this matter.

Sincerely,

MARILYN LLOYD, Chairman
Subcommittee on Energy
Research and Development

ML:cf
Attachment

32-540 - 90 - 6

Attachment

June 7, 1990

Honorable J. Michael Davis
Assistant Secretary for Conservation and Renewables
U.S. Department of Energy

1. What are the Departments plans for the development of building design tools utilizing Computer-Aided Design and Development (CADD) systems and advanced computer technologies?

REORGANIZATION

2. You mention that the reorganization was conducted by a special task force of professional conservation energy staff. Please explain the evaluation criteria used by the task force in determining the proper scope and funding of each program.

3. Were other groups representing the private sector or the federal laboratories consulted about the planned reorganization? Did they have an opportunity to make recommendations about the reorganization?

4. What form did the interaction take – meetings, memoranda?

5. Is the reorganization a result of the proposed national energy strategy? Were you asked to provide input to the energy strategy? What were your recommendations?

6. It appears that the restructuring of the renewable and conservation programs may require a restructuring of your annual budget proposal to the congress. Do you plan to restructure your budget submission for FY 1992?

7. I sense that the Solar Energy Research Institute (SERI) will be given a more active role in the reorganization. Please discuss how SERI's activities will be enhanced.

8. Do you expect that SERI's operating budget for in-house research and development activities will increase accordingly, or will most of the new funds be passed through to subcontractors?

9. Certain programs such as solar thermal are dispersed throughout several management areas i.e., solar detoxification, electricity, etc. How will you ensure that subprograms are coordinated and how will you track the funding for each program?

10. The Department of Energy publishes five year program plans for Renewable and Conservation Programs. Did the organization take into account the goals provided for each technology in the previously published plans?

INITIATIVES

11. How did you arrive at the 11 initiatives presented to Congress? What criteria was used to determine which program areas would benefit most by a special initiative?

12. Your planned five year total investment for the initiatives is $336.3 million. This represents a sizeable commitment to these activities. I believe our Subcommittee supports the intent of the initiatives to spur commercialization of near-term technology and to deploy already commercial technologies. However, of the 11 initiatives, only four call for research. Most others are implementation of existing technologies such as fluorescent lighting.

- With scarce research dollars, isn't there some other program that can provide needed funding?

13. In your description of the initiatives you mention that several are cost-shared between DOE and the private sector. However, in the solar detoxification discussion you do not mention cost-sharing. Do you anticipate receiving future cost-sharing for this activity?

14. While solar detoxification may more rapidly commercialize solar thermal components, wouldn't this research be best carried out by the Environmental Protection Agency?

15. Will the proposed new Solar Laboratory Building for SERI incorporate cost-effective applications of energy conservation, solar water heating, and passive solar materials?

PL 101-218

16. One major provision of P.L. 101-218 was to reauthorize the International CORECT Program and include energy efficiency technologies if used as part of Renewable Energy Systems. How has the CORECT Program worked with the renewable energy industry to plan to market activities in FY'91 and FY'92?

17. P.L. 101-218 required a series of joint ventures, what discussions have been held with industry to formally begin the joint venture development process, and has the Advisory Committee been formed, and if not, when will it be established?

FY 1991 BUDGET SUBMISSION

18. The Department's budget submission for Electric Energy Systems calls for approximately $15.0 million to be spent to expand the high temperature superconductivity pilot centers. Please give us a status report on the centers in terms of current activities and future plans. To date, approximately how much is industry cost-sharing toward projects?

19. Please discuss the Department's research efforts on electric field effects?

20. The Administration is proposing to almost double the Biofuels Research Program to focus primarily on alternative liquid fuels, but what program plans are developed for advanced R&D on direct combustion using wood waste, MSW, and agricultural residues?

21. Industry has expressed some concerns that the strong applied research programs at Sandia, Oak Ridge and Lawrence Berkeley Laboratories on renewable energy might be dismantled and shifted to SERI, is this your intent as Assistant Secretary?

22. The industry has strongly endorsed overseas design assistance activities of Sandia to

help build overseas markets, does the Department intend to continue these efforts in support of industry?

23. The Administration recommended cuts in the solar building programs in the energy & water development appropriations budget but made no recommended increase in the interior appropriations budget to carry on the active and passive solar research activities? How does DOE plan to continue active solar, solar cooling and passive solar research?

24. The energy conservation and production act directed DOE to take into account the impact of energy conservation standards on "habitability" and to "achieve a balance of a healthful dwelling environment and maximum practicable energy conservation". How successfully has DOE incorporated air quality goals into overall energy efficiency programs?

Department of Energy
Washington, DC 20585
August 24, 1990

The Honorable Marilyn Lloyd
Chairman
Subcommittee on Energy Research
and Development
Committee on Science, Space and Technology
U.S. House of Representative
Washington, D.C. 20515

Dear Madam Chairman:

On June 6, 1990, J. Michael Davis, Assistant Secretary for Conservation and Renewable Energy testified before your subcommittee on the DOE's Renewable Energy and Energy Conservation Research.

Following that hearing, you submitted written questions for our response to supplement the record. Enclosed are the answers to those questions.

If you have any questions, please have your staff call Fran Davis on 586-2759. She will be happy to assist you.

Sincerely,

Joseph C. Karpinski
Principal Deputy Assistant Secretary
Congressional and Intergovernmental Affairs

Enclsoures

QUESTIONS FROM LLOYD SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT

Question # 1: What are the Departments plans for the development of building design tools utilizing Computer-Aided Design and Development (CADD) systems and advanced computer technologies?

Answer: The Advanced Energy Design and Operation Technologies (AEDOT) project is developing automated energy design assistance that can be integrated into computer-aided design (CAD) systems of the future. These technologies include artificial intelligence, multimedia presentation, visualization techniques, analysis programs (DOE-2), and databases.

The Department's plans are to develop an AEDOT prototype over the next 3 years which would integrate expert systems and modular embedded "knowledge" with a commercially available CAD package. These knowledge bases are analogous to providing a designer with continuous access to a roundtable of energy design experts during all phases of design, an environment which is currently unavailable because of owner and economic constraints placed on the designer. Activities are now underway to collaborate with several universities, industry and other national laboratories. The areas of initial work will focus on energy considerations in predesign, daylighting and building energy standards.

Plans also include a parallel effort to form a government/industry consortium to develop an intelligent, computer-aided design framework. This framework would allow the research and development of multi-faceted tools for

all aspects of building design to be integrated into a generic system. A consortium would help to ensure that the products are viable and also provide multiple sources for cost-sharing.

Prepared by: Mark Bailey
Office phone: 586-9492
Date: June 15, 1990
Revised: June 16, 1990
Deputy Assistant Secretary:

Question # 2. You mention that the reorganization was conducted by a special task force of professional conservation energy staff. Please explain the evaluation criteria used by the task force in determining the proper scope and funding of each program.

Answer: The task force was charged to complete a review of the CE organization and was composed of a dozen mid-level staff. The average length of service for these individuals in conservation and renewable energy technologies exceeded ten years. A reorganization was not a given at the start of the process. However, the review was badly needed since the last comprehensive review was more than five years ago and did not focus on organizational efficiency but, rather on consolidation of programs and staff layoffs due to funding reductions.

The objective of the review was to determine organizational responsibilities and capabilities and then to identify options for functional and structural improvement within CE. The review did not examine scope and funding for any program. The process by which the review was conducted is described briefly:

Functional Analysis--In simple terms "what do we do". How has the basic charter and purpose changed for the CE programs? What are the legislative requirements which affect CE operations? What are the functional needs for CE? What are the priority internal and external organizational functions? How is the current organization structured (and how did it get that way)?

Operations Review--In essence this task looked at "how do we do what we do". What are the internal and external interfaces that must be satisfied? What are the current operational procedures? What are the internal and external operations having the highest priorities?

Personnel Review--Practically, this task looked at "who does what we do". What were the original organization personnel needs, how have they changed, and what are the current capabilities? What is the potential for re-assignment and re-training of existing personnel?

Based on the information developed from these analyses, much of which is defined in legislative language, a series of options was developed for achieving organizational efficiency. These options did not determine program scope and funding; rather, they provided means for accomplishing the CE mission with greater efficiency.

Prepared by: Phil Key
Office Phone: 9226
Date: June 12, 1990
Coordinated with:
Deputy Assistant Secretary:
Assistant Secretary:

Question # 3. Were other groups representing the private sector or the federal laboratories consulted about the planned reorganization? Did they have an opportunity to make recommendations about the reorganization?

Answer: A process of open information dissemination about the organizational review was instituted so that interested groups were informed about the process. Numerous contacts were made and maintained throughout the review, especially with constituent groups affected by conservation and renewable energy technology research and outreach programs.

Prepared by: Phil Key
Office Phone: 9226
Date: June 12, 1990
Coordinated with:
Deputy Assistant Secretary: Bob
Assistant Secretary:

Question #4. What form did the interaction take--meetings, memoranda?

Answer: The interaction with external groups representing the private sector took numerous forms, including individual and group meetings and telephone calls. All contacts were informal since the constituent groups were simply being kept informed of the review process. No formal meeting minutes or memoranda were kept.

Prepared by: Phil Key
Office Phone: 9226
Date: June 12, 1990
Coordinated with:
Deputy Assistant Secretary:
Assistant Secretary:

Question # 5. Is the reorganization a result of the proposed national energy strategy? Were you asked to provide input to the energy strategy? What were your recommendations?

Answer: The reorganization was not a result of the preparation of the national energy strategy (NES). The organization review was conducted separately from the public hearings and compilation of comment on issues and needs affecting development of a strategy for national energy policy. However, structure of the interim report for the NES includes many of the facets of the end-use sector structure featured in the CE reorganization.

The emphasis in the NES Interim Report was on public comment and descriptions of our national energy situation in terms of the technologies and resources available to affect supply and demand. In this context, CE did not comment; instead, the Office coordinated national laboratory analyses and white papers and worked with EIA to help describe U.S. energy use and future needs. The Assistant Secretary for CE or his Principal Deputy attended almost all the public hearings at the request of the Secretary.

CE is working with DOE's Office of Policy, Planning and Analysis to describe scenarios for future analysis in development of a strategy and will be heavily involved in completing these analyses for energy efficiency and renewable energy technologies. Recommendations for the national energy strategy will follow from this formal process.

Prepared by: Phil Key
Office Phone: 9226
Date: June 12, 1990
Coordinated with:
Deputy Assistant Secretary:
Assistant Secretary:

Question # 6. It appears that the restructuring of the renewable and conservation programs may require a restructuring of your annual budget proposal to the congress. Do you plan to restructure your budget submission for FY 1992.

Answer # 6. Yes. The CE budget will be submitted in two forms. The first will be the new end-use sector structure derived from the reorganization. The second will be in the traditional structure by the existing program decision unit. Each form will be "crosswalked" to the other, but only the end-use sector structure form may include more detail.

Prepared by: Phil Key
Office Phone: 9226
Date: August 14, 1990
Coordinated with:
Deputy Assistant Secretary:
Assistant Secretary:

Question # 7. I sense that the Solar Energy Research Institute (SERI) will be given a more active role in the reorganization. Please discuss how SERI's activities will be enhanced.

Answer # 7. SERI is already the lead laboratory for many of CE's research programs and is the only laboratory for which CE is the "landlord" under the DOE facilities management system. It is not expected that SERI's role will change as a result of the reorganization, but that funding placed there may increase due to requested increases in funding for research in technologies traditionally assigned to SERI. Likewise, it is expected that funding will increase at other national laboratories with specific historical roles in CE research and program activities for which the Office of Energy Research is the landlord. Examples would be Oak Ridge National Laboratory and Pacific Northwest Laboratory.

Prepared by: Phil Key
Office Phone: 9226
Date: August 14, 1990
Coordinated with:
Deputy Assistant Secretary:
Assistant Secretary:

QUESTIONS FROM Chairman Marilyn Lloyd

Question # 8. Do you expect that SERI's operating budget for in-house research and development activities will increase accordingly, or will most of the new funds be passed through to subcontractors?

Answer # 8. Historically SERI passes through more CE funding to industry through cost-sharing mechanisms, cooperative agreements and subcontracted research than other DOE national laboratories with other DOE funding. SERI's percentage of funding for supporting direct industrial research is nearly 35% including cost-shared and subcontracted research. It is not possible to state exactly what portion of any increase in funding would stay at SERI for in-house R&D or be placed in industry through competitive procurements, but the historical figure would represent the lower range since much of the funding represented by CE initiatives and requested budget increases has the stated purpose of enhancing industry participation in CE programs. As an example, the PV manufacturing initiative requested at $9 million for FY 1992 will place almost 90% of the funding with industrial participants cost-sharing in the program.

Prepared by: Phil Key
Office Phone: 9226
Date: June 12, 1990
Coordinated with:
Deputy Assistant Secretary:
Assistant Secretary:

Question # 9. Certain programs such as solar thermal are dispersed throughout several management areas i.e., solar detoxification, electricity, etc. How will you ensure that subprograms are coordinated and how will you track the funding for each program?

Answer: Program activities that were separated and moved to a new organization were placed in the new location on the basis of function; i.e., solar detoxification was placed in an organization whose purpose is waste utilization/destruction. Solar thermal electric should benefit from the separation since its personnel can fix their attention on the power generation application; solar detoxification staff should benefit from the expertise residing in the existing waste utilization organization. Technical staff knowledgeable in components and systems commonly used in solar thermal technologies were also transferred with the detoxification program to ensure hardware skills reside in each program. Coordination activity responsibilities have been written into management position descriptions through the Deputy Assistant Secretary level to ensure management attention to coordination of programs.

The organization review developed extensive historical data bases on funding respective to programs. These data bases establish a means for tracking budget formulation and execution functions for the new organization against appropriations in FY 90 and FY 91. In addition, extensive budget crosswalk information will be provided in our FY 92 budget request.

Prepared by: Phil Key
Office Phone: 9226
Date: June 13, 1990
Coordinated with:
Deputy Assistant Secretary: BAM
Assistant Secretary:

Question # 10. The Department of Energy publishes five year program plans for Renewable and Conservation Programs. Did the organization take into account the goals provided for each technology in the previously published plans?

Answer: Yes. A thorough review of all five-year plans and multi-year plans was completed as part of the organization review. This comprehensive review helped to establish where there were overlaps and duplication of research and outreach activities in existing programs; further, this aspect of the review provided substantial information on possibilities for achieving organizational efficiency.

Prepared by: Phil Key
Office Phone: 9226
Date: June 13, 1990
Coordinated with:
Deputy Assistant Secretary: BLD
Assistant Secretary:

Question # 11. How did you arrive at the 11 initiatives presented to Congress? What criteria was used to determine which program areas would benefit most by a special initiative?

Answer: During the course of FY 1989 program reviews senior management at DOE determined that conservation and renewable energy technologies needed additional emphasis to reflect administration policies. Based on this direction, development of the CE 11 initiatives presented to Congress was started with a request by ASCE to all CE staffers that they bring forth ideas to apply energy efficiency and renewable technologies to demonstrate the maturity in these technologies. The basis for the request was to use available funding, either prior-year deobligations or FY 89 carryover not critical to the original program budget intent, identified through a comprehensive budget analysis across all CE programs. Literally dozens of ideas were presented. Some of the submittals had to do with means to accomplish organization efficiency and were referred to the organization review task force. Some of the ideas dealt with complex research initiatives requiring multi-year efforts and, eventually, substantial funding. Since the funding was limited, the overriding criteria was to select initiatives that could accomplish the greatest near-term effect within that funding. Emphasis on this criteria also derived from the objective to begin to re-shape CE activities so that they included near-term applications activities as well as mid- and long-term research assignments.

Prepared by: Phil Key
Office Phone: 9226
Date: June 13, 1990
Coordinated with:
Deputy Assistant Secretary:
Assistant Secretary:

Question #12. Your planned five year total investment for the initiatives is $336.3 million. This represents a sizeable commitment to these activities. I believe our Subcommittee supports the intent of the initiatives to spur commercialization of near-term technology and to deploy already commercial technologies. However, of the 11 initiatives, only four call for research. Most others are implementation of existing technology such as fluorescent lighting. With scarce research dollars isn't there some other program that can provide needed funding?

Answer: We believe that a robust applied research program is one that works closely with U.S. industry to develop technological advances that will make a practical difference and that will be commercially attractive to develop. The four initiatives to which you refer will consume the lion's share of the resources we are committing, both in the current year and in the out-year plan. The other initiatives, although more modestly funded, are collaborative efforts that will make an important difference to the success of our technologies in the marketplace and thus are appropriately funded by CE. However, it is important to note that in some cases (e.g., Relighting Federal Facilities) the CE funding will serve to leverage substantially larger contribution from other sources (e.g., GSA and utilities).

Prepared by: Reid Detchon, CE-2
Office phone: 586-9220
Date: 6/20/90
Asst. Sec. Initials: BHP

Question # 13. In your description of the initiatives you mention that several are cost-shared between DOE and the private sector. However, in the solar detoxification discussion you do not mention cost-sharing. Do you anticipate future cost-sharing for this activity?

Answer: In the solar detoxification program, we anticipate cost-sharing with other government agencies and with industry. The program is already leveraging its funding in cooperative efforts with the Environmental Protection Agency (EPA) and DOE's Office of Environmental Restoration and Waste Management (EM). The EPA is spending $250,000 in FY 1990 to fund application studies, and is participating in reviews of the DOE program. DOE/EM has also provided $250,000 to date for R&D, and additional funds are being requested. Cost-sharing from industry on a 50-50 basis will be solicited primarily for field experiments.

Prepared by: Clifton Carwile
Office Phone: 586-5584
Date: 14 June, 1990
Asst. Sec. Initials: BAR

Question #14. While solar detoxification may more rapidly commercialize solar thermal components, wouldn't this research be best carried out by the Environmental Protection Agency?

Answer: The application of solar thermal technology to the detoxification of hazardous materials is a natural extension of research carried out by DOE over the last fifteen years. The two components that make up most of the cost of a solar detoxification system are the solar concentrators and the chemical reactors. The DOE experience is directly transferable to this new application. We believe that DOE should carry out this research because we have direct relevant experience. However, we are coordinating our work closely with the EPA. The EPA currently sits on an expert review board for the technology and is also funding its own assessment of the applicability of this technology to environmental problems. The experience gained in the hazardous waste area will also be directly applicable to other solar industrial applications such as industrial process heat and improved materials properties.

Prepared by: Clifton Carwile
Office Phone: 586-5584
Date: 14 June, 1990
Asst. Sec. Initials:

Question # 15. Will the proposed new Solar Laboratory Building for SERI incorporate cost-effective applications of energy conservation, solar water heating, and passive solar materials?

Answer: Yes. The design for the SERI Solar Energy Research Facility (SERF) will be updated and will include a review of all heating, ventilation, and air-conditioning (HVAC) systems and analyses of the building foundation, shell, and glazing systems for incorporation of cost-effective energy efficiency and renewable technologies.

Prepared by: Phil Key
Office Phone: 9226
Date: June 13, 1990
Coordinated with:
Deputy Assistant Secretary:
Assistant Secretary:

Question # 16: One major provision of P.L. 101-218 was to reauthorize the International CORECT Program and include energy efficiency technologies if used as part of Renewable Energy Systems. How has the CORECT Program worked with the renewable energy industry to plan to market activities in FY'91 and FY'92?

Answer: We have begun in-house planning to implement the Act's new authorities and requirements pertaining to CORECT. In this connection, we are working with the industry trade associations through their umbrella organization, the U.S. Export Council on Renewable Energy. We are particularly pleased that CORECT has been expanded to include energy efficiency technologies to the extent they are a part of a renewable energy system or technology. We believe this new authority will enable CORECT to expand substantially the export of non-polluting, cost-effective U.S. energy products and services.

Prepared by: Ralph Burr
Date: June 15, 1990
Coordinated with:
Reviewed by: J. Michael Davis, P.E.
Assistant Secretary
Conservation and Renewable Energy

Question # 17: P.L. 101-218 required a series of joint ventures, what discussions have been held with industry to formally begin the joint venture development process, and has the Advisory Committee been formed, and if not, when will it be established?

Answer: We are in the process of establishing the Advisory Committee. We have developed a list of potential members and have drafted a charter to guide the Committee in its work. Letters to the potential members inviting them to serve will be mailed shortly and we expect to hold the Committee's first meeting in August. We also have written to the five relevant industry associations and discussed methods to develop appropriate proposals for joint ventures authorized under this Act. In addition, we have begun the process of surveying member companies of these industry associations regarding their interest in joint venture arrangements.

Prepared by: Ralph Burr
Date: June 15, 1990
Coordinated with:
Reviewed by: J. Michael Davis, P.E.
Assistant Secretary
Conservation and Renewable Energy

Question # 18. The Department's budget submission for Electric Energy Systems calls for approximately $15.0 million to be spent to expand the high temperature superconductivity pilot centers. Please give us a status report on the centers in terms of current activities and future plans. To date, approximately how much is industry cost-sharing toward projects?

Answer: The three pilot centers have executed thirty-four collaborative research agreements with twenty-five companies. Some companies have agreements with all three centers and some companies have multiple agreements with a single center. The companies range from small venture capital-funded companies such as American Superconductor of Massachusetts, to large corporations such as IBM, General Electric, and Westinghouse. The usual agreement is between a private company and a national laboratory to investigate a topic of interest to the company, but several three-party agreements have been made. An example is one between DuPont, Hewlett-Packard and Los Alamos National Laboratory to develop thin-film electronic devices. This agreement is the largest made by the pilot centers and represents a three-year commitment of $11 million to be spent equally at the research facilities of each party. Industry cost-sharing must support at least 20% of the total cost of the research. Most companies support 50%, and in the case of the DuPont/Hewlett-Packard/Los Alamos agreement, 66%. The increased FY 1991 funding will permit the pilot centers to continue and augment existing agreements, increase the number of agreements, attract additional private sector funding, and help create a research focus on electric power applications..

Prepared by: Kurt Klunder
Date: August 14, 1990
Coordinate with:
Reviewed by: J. Michael Davis, P.E.
Assistant Secretary
Conservation and Renewable Energy

Question # 19. Please discuss the Department's research efforts on electric field effects?

Answer: The principal thrust of electric field effects research is a 2-step investigation: Whether electric or magnetic fields cause biological effects and whether biological effects, if present, result in health effects. Research funded by DOE has demonstrated that biological effects of such fields exist. However, definite health effects have not been proven scientifically. Work continues on humans, primates, rodents, tissues, and cells to investigate the precise nature of the interaction between low frequency electric and magnetic fields and biological organisms. Current interest centers on neurophysiology and abnormal cell growth and developmental problems. When the parameters involved in the biological interaction are defined and the effects are described quantitatively, then a more specific consideration of health effects, if any, can be undertaken.

Prepared by: Kurt Klunder
Date: 6/15/90
Coordinated with:
Reviewed by: J. Michael Davis, P.E.
Assistant Secretary
Conservation and Renewable Energy

Question # 20: The Administration is proposing to almost double the Biofuels Research Program to focus primarily on alternative liquid fuels, but what program plans are developed for advanced R&D on direct combustion using wood waste, MSW and agricultural residues?

Answer: The municipal solid waste (MSW) portion of the Biofuels Research Program will concentrate on combustion technologies for FY 1991. Plans include advanced combustion R&D for MSW, contaminated wood, and demolition materials, among others. Related efforts will develop comparative data on the energy, environmental and economic factors for MSW combustion, recycling and landfill; and research on improved, cost-effective air and ash emission controls. We anticipate reviewing the issue of agricultural residues in the near future.

Prepared by: Donald K. Walter
Office Phone: 586-4679
Date: 6/14/90
Asst. Sec. initials: GLO

Question # 21. Industry has expressed some concerns that the strong applied research programs at Sandia, Oak Ridge and Lawrence Berkely Laboratories on renewable energy might be dismantled and shifted to SERI, is this your intent as Assistant Secretary?

Answer: Conservation and renewable energy technologies need the strongest research base possible within available funding. In the early 1980s CE funded research at over ten laboratories (counting those not managed within the DOE national laboratory system), but the available research budget was many times larger than today. Parts of that extended structure linger on. Consolidation to a smaller number of DOE national laboratories is a necessity if we are to gain the maximum research and outreach productivity. This is not to imply, however, that substantial programs will be dismantled for the sake of consolidation. For example, Oak Ridge National Laboratory has leadership roles in buildings research and biomass feedstock development activities and its High Temperature Materials Laboratory has become a world-class facility; it will continue to perform these functions. In addition, please note that all changes in program assignments to date have been made in open consultation with the national laboratories senior management and the decisions have their support.

Prepared by: Phil Key
Office Phone: 9226
Date: June 13, 1990
Coordinated with:
Deputy Assistant Secretary:
Assistant Secretary:

Question # 22. The industry has strongly endorsed overseas design assistance activities of Sandia to help build overseas markets, does the Department intend to continue these efforts in support of industry?

Answer: Yes, the Department will continue this support of the industry.

Prepared by: Ralph Burr
Date: June 15, 1990
Coordinated with:
Reviewed by: J. Michael Davis, P.E.
Assistant Secretary
Conservation and Renewable Energy

Question # 23: The Administration recommended cuts in [illegible] solar building program in the energy and water development appropriations budget but made no recommended increase in the interior appropriations budget to carry on the active and passive solar research activities? How does DOE plan to continue active solar, solar cooling and passive solar research?

Answer: The FY 1991 request for solar heating is $1,000,000 from Energy and Water Development appropriations. For FY 1991, funding for solar cooling ($400,000) and day lighting activities ($1,400,000) has been requested as part of Building and Community Systems activities which are funded through Interior and Related Agencies appropriations. In addition, the work that has been done in Solar Buildings, particularly passive solar, will benefit from the large increase in requested funding for building design standards and guidelines, up from $792,000 in FY 1990 to the $5,000,000 request for FY 1991.

Prepared by: Kay O'Kelley
Office phone: 586-9123
Date: June 15, 1990
Revised: June 16, 1990
Revised: June 18, 1990
Revised: August 14, 1990
Deputy Assistant Secretary [signature] for [illegible]
8/15

Question # 24. The energy conservation and production act (ECPA) directed DOE to take into account the impact of energy conservation standards on "habitability" and to "achieve a balance of a healthful dwelling environment and maximum practicable energy conservation". How successfully has DOE incorporated air quality goals into overall energy efficiency programs?

Answer: DOE formally carries out this responsibility by conducting an environmental assessment for each of its building standards rulemakings. In these assessments, "habitability" is expressed in terms of changes in various indoor air pollutant concentrations and concomitant occupant health and safety effects that can be related to design changes attributed to the proposed standards. Recent assessments considered incremental changes in pollutant concentrations for radon, formaldehyde, particulate matter, carbon monoxide and carbon dioxide. To date, these assessments have found no significant increased health risk associated with the building standards.

In addition to its rulemaking responsibility, DOE contributes to the goals of ECPA by participating in a Federal research program on the topics of indoor air quality, infiltration and ventilation. Primarily an expansion of earlier Federal buildings energy research, this program seeks to quantify the relationships among reduced infiltration, adequate ventilation, and acceptable indoor air quality (IAQ). Notable past accomplishments include: 1) an evaluation of energy efficient radon control techniques, 2) field studies of IAQ in energy efficient new homes, 3) development of measurement techniques for ventilation and IAQ studies, 4) development of air leakage measurement techniques, and 5) evaluation of advanced ventilation techniques.

Prepared by: John Talbott
Office phone: 586-9455
Date: June 15, 1990
Revised: June 16, 1990
~~Depuey~~ Assistant Secretary: